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JANUARY, 1919

THE SCIENTIFIC MONTHLY

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A Remarkable Textbook

Barber's First Course in General Science

By FREDERICK D. BARBER, Professor of Physics in the Illinois State Normal University, MERTON L. FULLER, Lecturer on Meteorology in the Bradley Polytechnic Institute, JOHN L. PRICER, Professor of Biology in the Illinois State Normal University, and HOWARD W. ADAMS, Professor of Chemistry in the same. vii+588 pp. of text. 12mo. \$1.25.

A recent notable endorsement of this book occurred in Minneapolis. A Committee on General Science, representing each High School in the city, was asked to outline a course in Science for first year High School. After making the outline they considered the textbook situation. In this regard, the Committee reports as follows:

"We feel that, in Science, a book for first year High School use should be simple in language, should begin without presupposing too much knowledge on the part of the student, should have an abundance of good pictures and plenty of material to choose from.

Barber's *First Course in General Science* seems to us to best meet these requirements and in addition it suggests materials for home experiments requiring no unusual apparatus, and requires no scientific measurements during the course. We recommend its adoption."

Other Interesting Opinions on the Book Follow:

SCHOOL SCIENCE AND MATHEMATICS:—It is one of the very best books on general science that have ever been published. The biological as well as the physical side of the subject is treated with great fairness. There is more material in the text than can be well used in one year's work on the subject. This is, however, a good fault, as it gives the instructor a wide range of subjects. The book is written in a style which will at once command not only the attention of the teacher, but that of the pupil as well. It is interesting from cover to cover. Many new and ingenious features are presented. The drawings and halftones have been selected for the purpose of illustrating points in the text, as well as for the purpose of attracting the pupil and holding his attention. There are 375 of these illustrations. There is no end to the good things which might be said concerning this volume, and the advice of the writer to any school board about to adopt a text in general science is to become thoroughly familiar with this book before making a final decision.

WALTER BARR, Keokuk, Iowa:—Today when I showed Barber's Science to the manager and department heads of the Mississippi River Power Co., including probably the best engineers of America possible to assemble accidentally as a group, the exclamation around the table was: "If we only could have had a book like this when we were in school." Something similar in my own mind caused me to determine to give the book to my own son altho he is in only the eighth grade.

G. M. WILSON, Iowa State College:—I have not been particularly favorable to the general science idea, but I am satisfied now that this was due to the kind of texts which came to my attention and the way it happened to be handled in places where I had knowledge of its teaching. I am satisfied that Professor Barber, in this volume, has the work started on the right idea. It is meant to be useful, practical material closely connected with explanation of every day affairs. It seems to me an unusual contribution along this line. It will mean, of course, that others will follow, and that we may hope to have general science work put on such a practical basis that it will win a permanent place in the schools.

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THE SCIENTIFIC MONTHLY

JANUARY, 1919

WEATHER CONTROLS OVER THE FIGHTING DURING THE AUTUMN OF 1918¹

By Professor ROBERT DeC. WARD

HARVARD UNIVERSITY

THE Allied advance on the western front, which began on July 18, continued into the autumn with remarkable success until the ending of the war. Almost every day brought the news of a gain of territory; of the recapture of towns and villages; of the taking of prisoners and of guns. It seemed as if weather conditions, however unfavorable, could hardly make any difference in the carrying on of so aggressive a campaign, yet the autumn of 1918 was, in many respects, the most critical season, meteorologically, of any period of equal length during the whole war. It is easy to understand why this was the case. In the preceding years of the war, the winter storms, and cold, and mud on the western front necessitated a decided slackening of military operations between about the middle of November and early December. This happened in spite of emphatic

¹ Continued from THE SCIENTIFIC MONTHLY for October, 1918, p. 298.

Author's Note.—This series of papers on the weather factor in the Great War comes to a conclusion with the signing of the armistice by Germany. In the preparation of these articles, published in THE SCIENTIFIC MONTHLY and elsewhere, the writer had two things in mind. It was his belief that, as a part of the scientific history of the Great War, as full an account as possible should be kept of the meteorological conditions which affected the operations on all the battle-fronts. The other object was a practical one. It was felt that a discussion of the climatic conditions of the various war zones, and of the meteorological difficulties which were likely to affect, and which did affect, military operations, might be of some help in our own preparation for and conduct of the war. The facts set forth in these papers were collected from all available, reliable sources of information, chiefly the official headquarters' despatches, and the letters of well-known war correspondents. Later, and more complete, information may indicate that some of the statements which the writer has made should be modified, but it is his belief that what has been included is essentially complete and essentially correct.

predictions, previously made by the military commanders, that the fighting would "continue as usual throughout the winter." The 1918 summer and autumn campaign on the part of the Allies was perfectly clearly a neck-and-neck race with the weather. It was the business of the Allies to force an overwhelming defeat of the German armies during the few remaining weeks of "fighting weather," and to make it impossible for the enemy to postpone the final decision until after another winter of relative inactivity. Again, in case a definite military decision should prove unattainable before winter, it was clearly to the advantage of the Allies to push on, beyond the area of destruction and desolation left by the Germans during the earlier part of their retreat, where there were no houses or shelters of any kind and no fuel, to the towns and large cities of eastern France and Belgium. Here adequate provision for billeting the soldiers could be made. The Hindenburg Line itself, with its elaborate concrete shelters and dugouts, was an important objective before winter, for this same reason. Mr. Charles H. Grasty, the well-known *New York Times* correspondent, in a cabled despatch from Paris, dated September 11, reported having asked a French military authority why the Allied troops did not rush ahead and crush the Germans at once. The reply was:

There's one Generalissimo whom all belligerents take orders from, General Mud. If we could continue summer weather conditions another three months, we might get a decision. But it's unsafe to reckon on more than five weeks of good offensive weather. From the Somme to the Channel the character of the soil renders the mud the worst in all creation after the autumn rains begin in good earnest.

The Germans, on their part, had every reason for prolonging the fighting until the advance of winter should delay the enemy pursuit, and bring a cessation of active operations. Germany would then be in a position to rest and to reorganize her forces, and to suggest peace negotiations on the basis of a stalemate on the western front. Both sides were thus fighting with the strongest possible meteorological pressure behind them. For both sides, everything depended on the time of the setting in, and upon the severity, of the winter.

During the first days of September, the despatches mentioned the "unprecedented dryness" of the season as having been remarkably favorable for the movement of the Allies' troops, guns, tanks and supplies. In the absence of direct meteorological records from overseas, it is impossible to determine whether the term "unprecedented dryness" was war-

ranted, but it is clear that the roads were in good condition and that the Germans tried to hamper the Allied advance by flooding, wherever possible. The autumn rains were, however, not long delayed. For about a week, following September 8, heavy storms and chilly winds swept the entire battle area, slackening the progress of the Allies but not stopping their steady, although slower, advance. The men were drenched to the skin, and "felt the wind like a knife-blade." Yet there was a blessing in the rain, well recognized by some of the troops, for it laid the dust which was blowing from the battlefields covered with dead bodies of men and of horses, and it prevented the explosion of many shells which struck in pools of water.

As the milder and more peaceful weather of summer on the western front gradually gives way to the stormier and more turbulent autumnal types, it is inevitable that active military operations should be oftener slackened, or even entirely interrupted. The fighting conditions are less favorable. The weather changes are more frequent and violent. The rain is more chilling, and snow and sleet begin to fall. Observation, on the surface or in the air, becomes more difficult, often even impossible, owing to clouds, or mist, or fog. Gunfire becomes inaccurate. Lower temperatures, especially during the autumnal nights, cause discomfort or suffering, and bring calls for warmer clothing and for fires. The traditional mud of Flanders makes the most serious trouble during the autumn rains, which are characteristic of that region. Flanders mud has played its part in every war fought over this same territory throughout history, and has over and over again proved a serious handicap in the present war. This mud is most troublesome in the colder months, for storms are then most, and spells of fine weather then least, frequent. The rains on the western front are not unusually heavy in the sense that they give a large annual rainfall, but they come fairly steadily throughout the year; the country is mostly very flat and poorly drained; the soil is quickly water-logged, and the trenches and shell-craters serve as so many reservoirs for collecting water. "Seas of mud," "quagmires," "morasses," "bogs" are expressions used to describe conditions which have prevailed since the war on the western front began. Incessant labor must be expended to keep the roads in condition for traffic. The rivers are frequently in flood, carrying away bridges and turning the lower lands into temporary shallow lakes. The relation between the weather and military operations, especially in autumn and winter, is like a see-saw. Spells of stormy weather and of deep

mud mean tremendous difficulties of transportation and of troop movements, and hence involve a slackening of operations. Spells of fine weather mean greater aerial activity; more intense artillery action, and more favorable conditions for all movements.

With the progression of the seasons, from summer to fall, it was inevitable that what has happened in the past four years on the western front would happen again in the autumn of 1918. There is no reason to suppose that the months of September, October and November of the present year were any more unfavorable, or brought any more rainfall, than they normally do, although the official despatches, and the war correspondents' cabled letters, lay unusual emphasis upon meteorological handicaps. This fact is, however, doubtless due to the intensity of the fighting, and to the tremendous effort which the Allied forces were making to bring the war to a successful ending before winter set in. It would be a tedious repetition to enumerate here all the many cases in which weather conditions controlled the military operations on the western front during the past autumn. The rains; the chilling winds; the low clouds; the fogs; the cold nights; the mud; the water-filled shell-craters; the flooded rivers; the swamps—all played their part. Sometimes weather conditions favored the enemy; sometimes they favored the Allies. On the whole, every bit of delay resulting from stormy weather and difficulties of transportation worked in favor of the enemy, for it gave him just so much more time to organize his retreat and remove his supplies, and it hampered just so much the Allies' progress in their pursuit of the retiring Germans. The successful elimination of the St. Mihiel salient by French and American troops just before the middle of September, although it occurred early in the autumn, furnished striking illustrations of the meteorological difficulties with which the armies had to contend. The advance was begun early in the morning after a rainy night, in a driving rain and mist which made aerial observation difficult, and was followed by a strong westerly wind which hampered balloon and airplane work. The roads were deep in mud, and the fields soggy. The movement of heavy guns and transports was very difficult, the mud proving too much for many of the tanks, although these were small and relatively light, and had a wide tread. "The infantrymen slipped and waded in pursuit of the retreating enemy." In spite of the bad weather, American bombers did effective work, driving down enemy airplanes and balloons and attacking German supply trains. The main road

of the enemy's retreat became congested because of the mud, and here the American aviators, flying very low, were able to use bombs and machine guns to good effect.

Over and over again, with almost wearisome monotony, the despatches throughout the autumn mention the extraordinary difficulties resulting from the bad weather and the mud. But throughout all the reports there runs the splendid story of the advance of the Allied troops in spite of all obstacles; and of the cheerful endurance, on the part of the men, of discomfort and suffering in the cold and wet. One despatch (September 12) mentioned the pouring rains which forced "the Allied airmen to cease their punishment of the Germans." On September 30 "wintry winds and rains, sweeping in from the North Sea," drenched the men, and chilled them to the bone. Under that date Mr. Philip Gibbs cabled to the *New York Times*:

There was wild weather last night, with a gale of wind blowing and heavy rainstorms over the battlefields. . . . It was bitter cold for the brave troops, and this morning some of them I met had chattering teeth, after a night without sleep, but they endure these discomforts bravely, and the vision of victory keeps them warm in soul, if not in body.

Advancing autumn brought the more stormy weather which is characteristic of October and November on the western front. Special mention was several times made of the extraordinary difficulties encountered by the American troops in the Argonne forest, where, in addition to the natural handicaps resulting from the terrain, there were the barbed wire, and traps, and machine gun nests, and "mud and rain—everlasting rain" (October 1). Many supplies had to be carried on the backs of the soldiers. "I guess he (the enemy) is as wet as I am, and that helps some" was the statement of an American soldier to a war correspondent. A cable despatch to the *New York Times* (October 1) contained this significant statement: "The elements continue unfavorable. To say that the continued rain is German weather is no figure of speech, for our supplies and guns and ammunition must be brought up through seas of mud. . . ." That such conditions hampered the Allies was generally recognized, and on one occasion (October 16) the Germans, "favored by the bad weather and bad roads" which slowed up the Allied supply trains, made a temporary stand on a line from the region north of Sissonne to Rethel.

In the Flanders region, as a correspondent cabled on October 15, "the battle may be said to be almost as much against the weather and the mud as against the Germans. But, while this sort of sticky ground hampers the Allied troops, it hinders

even more the enemy, who is trying to move his materials away under a heavy fire and through the mired ground of the Flanders lowlands." That the Allied advance continued in spite of the extraordinary handicaps of weather, and mud, and difficult transport, is remarkable. Mr. Philip Gibbs cabled to the *New York Times* on October 23:

The British troops slogged through water pools and trudged down rutty roads with the mud splashing them to their neck, while lorries surged along broken tracks, swung around shell craters and skirted deep ditches. Gun teams with all their horses plastered to the ears with mud traveled through the fog to take up new positions beyond the newly captured towns. All this makes war difficult and slow, and what is most amazing is the speed with which the armies are following up the German retreat like a world on the move, with aerodromes and hospitals, telegraph and transport, headquarters staffs and labor companies, all the vast population and mechanism which make up modern armies, across battlefields like the craters of the moon to country forty miles from their old bases.

In the latter part of October the Germans were using a great deal of mustard gas against the American troops. This gas is reported to be especially dangerous in wet weather, because in damp air it remains long in the hollows, where the shells land, and it also burns through wet clothes more easily than through dry.

Two branches of military activity are peculiarly hard hit by stormy weather. Tanks can only be used with difficulty, if at all, in deep mud, and heavy rain and low clouds prevent almost all aerial work. Balloons are not sent up and airplane observers, when they fly at all, can see only when very close to the ground. "German weather" was reported November 4. Heavy rains forced the Allies to advance slowly. The increasing distances from headquarters to the front added daily to the tremendous task of repairing roads, and of maintaining transport. On November 5, because of bad weather, the Allied front line troops lost touch with the main body of the enemy. On the same day Field Marshal Haig reported: "In spite of a heavy and continuous rain our troops have pressed the retiring enemy forces closely throughout the day, driving the rearguards wherever they have sought to oppose our advance and taking a number of prisoners." Persistent and heavy rains, or thick mists, continued along the whole battle-front until hostilities ceased. In spite of "very difficult weather," and of the deep and sticky mud, the Allied troops continued to make remarkable progress. These unfavorable conditions were bad for the Allies, because the pursuit was slackened, as was clearly indicated in the despatches, but, as one correspondent emphatically expressed it,

"the imagination fails to conceive what it must be on the German side of the lines, where the retreating army looks back over its shoulders at the menace in pursuit, and where every block of traffic means terror, or death, or capture, because the British flying men are out, and the British guns are pounding the roads, and British troops are marching on."

Early morning fogs, or "mists," often served as a screen for the attacking troops. Such cases occurred on the British front, in the Douai-Cambrai region, on September 27, where the fog "assisted in bewildering the enemy"; on September 29, on the St. Quentin front, where the fog was so thick that it was impossible to see "the length of a gun-team ahead"; on the American front in the Argonne forest on October 1, when the small tanks came out of the fog, unexpectedly, "like phantoms," and fell on the Germans in the rear; in the sector south of Cambrai on October 8, where British, French and Americans launched an attack in a thick "mist" and fog. Again, on October 9, a fog "proved a big help" to the American attacking troops in the Argonne forest. On October 18, in the Le Cateau sector, "American tanks . . . crossed the Selle River in a dense fog, steering by compass, leading the attack against the Germans. Prisoners said they were overcome by the suddenness of the arrival of the tanks in the fog." Other cases occurred on October 24, on the American front, and also on the British front in Flanders. The "thick wet fog" in the latter case was reported as very much in favor of the attacking troops, for it "blinded" the German machine gunners. November 1 and November 3 furnished further illustrations of similar conditions on the American front. In the advance on Landrecies the tanks had to steer by compass through the dense white fog of early morning. One report (November 8) mentions the fact that, owing to an all-day fog, American aviators were unable to keep watch on the retreating enemy, and this aided the German withdrawal.

The effect of spells of fine weather must not be lost sight of. In the midst of the storms, which are the dominant condition on the western front in the autumn months, the rarer spells of dry, clear weather are peculiarly welcome, and exert marked controls over military activities. Thus, on September 15-16, fine weather, "with just the first touch of autumn in the wind at night" but with warm "perfect" days, was a welcome relief to the men, and a real help in the work of road-mending and of railway and camp construction. Every spell of fine weather brought increased activity, especially in the air. Un-

der date of September 27, Mr. G. H. Perris cabled to the *New York Times* from the French front:

It was a matter of universal congratulation that the morning fog had early given way before the bright sunshine. A mist at the hour of assault is not an unmixed disadvantage, for it covers the infantry advance and blinds the enemy machine gunners; but the importance of aerial observation, especially for the correction of artillery fire, has become so great that the momentary screen gained by the ground forces is no compensation for the crippling of the aviators. A burst of fine weather at such a juncture has also a considerable moral influence. No man is quite strong enough to be indifferent to accident; and, as when a vast and perilous venture falls upon bad conditions, those who must sustain it are discouraged as well as obstructed, so the happier turn of fortune is a double aid.

Good weather on October 1 "did wonders for us in the way of repairing the roads, and to-day's reports are that traffic conditions have improved 100 per cent. over two days ago, when, it may be stated, our service of supply was in a sorry plight through no fault of its own." The comfort of the men is obviously greatly affected by the weather conditions. Dry spells, with improved transportation, mean more regular and better meals, and dry blankets, to say nothing of the cheering effect of sunshine on the spirits of the men.

Preparations had been made for carrying on the war through the winter. Under date of October 4 it was reported that most of the American troops had been supplied with sleeveless, felt-lined leather coats, "while trucks moving from the rear bore ton upon ton of overcoats." At the end of October, the Forestry Section of the A. E. F. promised to have ready by January 1, 1919, 100,000 cubic meters of fuel wood. This was to come from dead wood and from refuse in the forests. No fine trees were to be cut.

Early in October (third) the statement was made, in a despatch from overseas, that American naval officers looked for increasingly difficult times for the German submarines. In summer, by operating far out, the losses may have been reduced, as well as the successes, but the coming on of winter storms was expected to drive the submarines into more sheltered waters, where air patrols, and submarine chasers and destroyers would have a better chance to attack them. A good deal was said about the relatively small amount of aerial activity on the part of the Germans during the summer and early autumn. In explanation of this fact, some of the Allied aviators maintained that the enemy machines were being conserved by using them on cloudy days only. They could then navigate by

compass above the clouds; swooping down when necessary, and then disappearing again within the clouds. An interesting case of camouflage was reported in connection with the use by the Allies of figures of soldiers painted on thin boards, and cut out very much as paper dolls are cut out by children. During the night these silhouettes were placed out in open order in front of the lines, and on a foggy morning, being mistaken by the Germans for real men, usually drew the enemy's fire and thus revealed the position of the enemy's guns in advance of the attack.

On the Italian front there was little activity until late in October. Early in September (fifth), in the northern part of the Tonale Pass, there was hard fighting "among the eternal snow and ice." On September 25, Italians and Czecho-Slovaks made a surprise attack on the Asiago Plateau in a violent storm. On October 24 a new—and the final—Italian and Allied offensive began on the mountain front between the Brenta and Piave rivers, in unfavorable weather. The time of the year was certainly not propitious for a mountain campaign, for by late October the snowfall in the mountains is already considerable, and almost certain to cause serious difficulties of troop movements and of transport. The reason for beginning the offensive at that time was doubtless to be sought in the political condition of Austria-Hungary. On the other hand, on the southern Piave, winter fighting is quite possible, for the precipitation there is rain rather than snow. It may be that General Foch had planned the Italian offensive for a time when Austria's main lines of communication with the front should be blocked with snow. The weather in the mountains was reported as unfavorable (October 24-29), but the Italian troops were successful. The Italian statements regarding the operations on the Piave were rather guarded. Conditions had threatened a rise in the river, but with three successive days of fair weather (October 30) a large body of troops was able to cross the Piave, and continue their pursuit of the retreating enemy. The danger that a sudden fall of rain in the mountains would bring the Piave down in flood, as happened during the last Austrian offensive, did not occur, although there were reports on October 28 that operations had been checked by a rise in the river. Military operations on the Italian front ended when the armistice went into effect, November 4.

In Mesopotamia and Palestine the British forces achieved complete success. Because of the "closed season," resulting from the heat and drought of the summer, little was heard of

Gen. Allenby after the first of May, when he had taken Es-Sault, and had reached a point on the railroad about 110 miles from Damascus. Some details, not earlier available, have come through regarding the difficulties which were met with in the progress of the campaign which followed the capture of Jerusalem (early December, 1917). These facts are taken from a diary of a member of the Imperial Camel Corps, and were sent to this country by Mr. Allan Hunter, a member of the American Red Cross in Palestine. That being the rainy season in Palestine, the trouble, as was to be expected, was mostly with the rain and mud. Immediately after crossing the Jordan, "there was a huge dust storm, accompanied by rain, which made it very unpleasant." The men suffered greatly because of the frequent rains and cold. The mud became "simply atrocious." On one occasion the camels had to be pulled along by their bridles. "The trek was literally through feet of mud and water." Just before reaching Es-Sault "hailstones and bitter cold and the usual mud" were experienced. There is also reference to "very heavy dew, which went through bivvy sheet and valise and waterproof sheets." These heavy dews are a well-known climatic characteristic of Palestine, especially on the interior highlands.

Gen. Allenby started his autumn (1918) campaign very early (September 19), before the best season for military operations in Palestine usually begins, doubtless in order that he might have the whole of the campaign season before him. One point in the British advance is especially interesting. This being still the dry season, marching troops naturally raise clouds of dust, and their movements are thus revealed to the enemy. It was doubtless partly for this reason that Gen. Allenby's troops "were always moved by night, and remained hidden in the orange and olive groves in the daytime." In Mesopotamia, also, the hot summer was a time of relative inactivity, but with the coming of autumn the British forces advanced up the Tigris in coordination with the movements of Gen. Allenby's forces in Palestine. The result of the combined operations is well known. The Turkish armies were defeated, and Turkey was driven to surrender.

From Russia, in its state of chaos, but little trustworthy news has come through. As early as August 28 a despatch from Archangel referred to the work of an Allied commission which was then considering the question of supplying the people with winter clothing and with provisions. An interesting despatch (September 4) mentioned the arrival of American

troops at Archangel, most of them being "from States where the winters are like those of Russia." Under date of October 20, a press despatch from Archangel reported:

An unusually late winter in northern Russia was ushered in to-day by a heavy fall of snow. The Dvina and Vaga Rivers, which usually are closed at this date, are still ice free. The American and other soldiers are being equipped with semi-arctic uniforms, including sheepskin great-coats and Arctic felt boots.

In Siberia, preparations for a hard winter's fighting were being made early in September. American troops were then being fitted out with fur caps, mittens, overcoats and heavy fur-lined shoes. "They will wear the same clothing as troops stationed in Alaska." "Typical American fall weather" was reported as prevailing at Khabarovsk on the arrival of American troops there (October 14). From the American Government, through the Red Cross, 75,000 sweaters and overcoats for the Czecho-Slovak troops arrived in Vladivostock on October 16. As an "emergency relief," other supplies of warm clothing had been previously distributed to these troops. One of the most difficult questions confronting the Allies in Siberia was that of transportation by the Trans-Siberian road during the severe cold and icy gales of winter.

From the Balkans there were very few reports of meteorological interest. Quick work by the Allied troops was imperative, for the winters of the Balkan mountains begin early, and are severe. Increasingly unfavorable weather was noted early in October. The ending of the war before mid-autumn came at the time when military operations in the Balkan highlands are usually beginning to be seriously interfered with by bad weather.

Thus ends the meteorological chronology of the war which has been the subject of the present series of articles. When the complete scientific history of the Great War comes to be written, by no means the least important, or least interesting chapter will be that which relates to the weather controls over the operations on all the fronts. It is the hope of the writer that the facts which he has collected and summarized in the series of articles now ending may be a helpful contribution to the more complete discussion which may follow.

SOCIAL AMELIORATION AND EUGENIC PROGRESS

By Professor S. J. HOLMES

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THE relation between social progress and the improvement of the inborn qualities of the human race is a question upon which we meet with much difference of opinion. The progress in ideas and institutions which forms so conspicuous a feature of our recent history by no means implies a corresponding improvement in the characteristics that we owe to heredity, and in fact may go along with biological decadence. Civilization, biologically considered, is a comparatively recent and somewhat anomalous racial experience, and it brings in its train a number of agencies which tend to oppose the operation of those selective forces which most biologists regard as mainly responsible for the evolution of organic life. Our modern warfare in leading to the elimination of our best stocks; our fostering of the weak and defective; the decline of the birth rate among those classes of society which have risen into the successful ranks—all tend to recruit the next generation from stocks of relatively inferior racial qualities. There is little doubt that the most potent of these forces is the relative sterility of those classes whose inheritance of desirable traits of mind and character we have every reason to believe is above the average. In the animal world individuals that attain supremacy over their fellows generally succeed in leaving the most numerous progeny. But under modern social conditions this natural relationship between net fecundity and the qualities that lead to supremacy has undergone a curious reversal. Those who succeed leave few offspring, while the failures, the mentally subnormal and the improvident who are restrained by no considerations of prudence from perpetuating their kind and leaving them to the tender mercies of Providence or the poorhouse, continue to multiply with relatively unabated rapidity. Whatever may be the forces working towards the improvement of our hereditary endowments, it is evident that so long as preponderating fecundity belongs to those who drift instead of to those who attain mastery the race stands in very serious danger of deterioration.

It is unnecessary to dwell further upon this situation which has been discussed so frequently in recent years. Our present aim is to enquire whether or not the future improvement of our social institutions, granting that they continue to improve, promises to counteract, in any effective way, the forces that are now working toward racial decadence.¹ Most people look forward optimistically to an era of accomplished reform when education and culture will become much more widely spread, when wealth will be more equitably distributed, and when people in general will be good and happy. Assuming that these sanguine expectations will be in the main fulfilled, what will be the probable effect upon our racial inheritance?

Unless one were a Lamarckian and believed that the results of individual improvement were bequeathed to following generations, the answer to this question would not be immediately evident at least. Most biologists at the present time are not Lamarckians, and their answer to the question would probably depend upon their estimate of the way in which the various selective agencies to which mankind is exposed are affected by social progress. There are many factors, both social and biological, which must be considered in dealing with this problem; and judging from the expressed opinions of a number of biologists one may be pretty sure that the question would be answered in several different ways.

Writers on social evolution often assume a certain antagonism between racial welfare and the general improvement of the conditions of life. Conditions must be bad enough, at least for a goodly number of people, so that the "beneficent working of the survival of the fittest" is not interfered with. Herbert Spencer warns legislators against any artificial interference with the competition whereby the ill-endowed are condemned to "abject misery" and early death. "Manifestly," he says, "an opposite régime, could it be maintained, would, in course of time, be fatal to the species." According to Professor Haeckel,

The theory of selection teaches us in human life, exactly as in animal and plant life, at each place and time only a small privileged minority can continue to exist and flourish; the great mass must starve and more or less prematurely perish in misery. . . . We may deeply mourn this tragic fact, but we can not deny or alter it. "Many are called but few are chosen." This selection, this picking out of the chosen, is necessarily combined with the languishing and perishing of the remaining majority.

¹ A discussion of some of these forces is contained in an article by the writer on *The Decadence of Human Heredity* which appeared in the *Atlantic Monthly* for Sept., 1914.

If the weak must be crushed in order that the best types may inherit the earth it is obvious that a condition of society which greatly improves the living conditions of the less highly favored of the human breed would be fatal to the evolution of the race.

It is scarcely necessary to point out that Haeckel's picture of selection in human society is grossly overdrawn. But the central idea expressed, *i. e.*, the necessity for maintaining the struggle for existence in order to insure progress, is voiced by a number of post-Darwinian writers on social evolution. To quote the words of a prominent social Darwinist, Mr. Benjamin Kidd:

We shall perceive, when we understand the nature of the forces at work beneath the social phenomena of our time, that in whatever direction we may cast our eyes, there is no evidence that the rivalry and competition of life, which has projected itself into human society, has tended to disappear in the past, or that it is less severe amongst the most advanced peoples of the present, or that the tendency of the progress we are making is to extinguish it in the future. On the contrary, all the evidence points in the opposite direction. . . . The races who maintain their places in the van do so on the sternest conditions. We may regulate and humanize those conditions, but we have no power to alter them; the conflict is severest of all when it is carried on under the forms of the highest civilization. The Anglo-Saxon looks forward, not without reason, to the days when wars will cease; but without war, he is involuntarily exterminating the Maori, the Australian, and the Red Indian, and he has within his borders the emancipated but ostracized Negro, the English Poor Law, and the Social Question; he may beat his swords into ploughshares but in his hands the implements of industry prove even more effective and deadly weapons than the swords.

These are the first stern facts of human life and progress which we have to take into account. They have their origin not in any accidental feature of our history, nor in any innate depravity existing in man. They result, as we have seen, from deep-seated physiological causes, the operation of which we must always remain powerless to escape.

Individual man, as Mr. Kidd conceives him, is but a pawn in Nature's game—a game in which he as an individual has no particular interest. Nature, "so careful of the type" and "so careless of the single life," is ever ready to sacrifice the individual in the interest of the social organism to which he belongs. "The teaching of reason to the individual," says Mr. Kidd, "must always be that the present time and his own interest therein are all-important to him. Yet the forces which are working out our development are primarily concerned not with these interests of the individual, but with those widely different interests of a social organism subject to quite other conditions and possessed of an indefinitely longer life."

To induce man to sacrifice his interests and to work for the

welfare of his social group is a problem which Nature has solved by endowing him with various social instincts and emotions, and particularly with those traits which make him a religious animal. As only egoism is rational, according to Mr. Kidd, man must be bamboozled into altruism in some way if Nature is to gain her end of promoting human progress for which, it is claimed, there is "no rational sanction." To effect this consummation is the lofty function of religion. By furnishing him with non-rational sanctions for conduct which makes for social as opposed to individual welfare, Nature has made man a willing dupe, content to tolerate a social system in which natural selection has free play and in which much misery must be endured in order that social evolution may continue its course.

This is, I think, a fair statement of Mr. Kidd's view, though expressed in phraseology less dignified and persuasive than that which captivates the readers of "Social Evolution." It is but natural for Mr. Kidd to conclude that the evolution which is now going on in the human race, and which has been going on for many centuries, is not primarily in the field of intellect, but of instinct. Nature does not favor the development of intellect beyond the point at which the latter becomes unmanageable and refuses to subordinate itself to Nature's ends. The great danger that comes from the gradual extension of the sphere of individual rights, and the emancipation of the intellect from the reign of dogma is that the subordination of individual to social welfare may become so weakened that the life of the group is seriously imperiled. A discordant individualism is a decided military disadvantage, whatever may be said for it in other relations. Selection would therefore favor those groups in which the instincts that secure subordination and effective coordination were best developed, and in which the intellect was kept in a proper subjection to the instincts which afford the basis of social organization.

From Mr. Kidd's standpoint the prospect of much further advancement of the intellectual endowments of the race is not encouraging. Reason, being essentially anti-social, must be directed to social ends by instinct, or through institutions founded on instinct, which afford the necessary non-rational sanctions for social behavior. It is assumed that whatever advances we may make in the future must be accomplished through intense rivalry and the elimination of the unfit. Rivalry within the group leading to the suppression of inferior individuals, and rivalry between groups leading to the elimina-

tion of tribes and nations which have less corporate efficiency must continue to exist unless degeneration overtake the race. Racial progress, like the bloodthirsty gods of the ancient Aztecs, must have its human victims. If our social order does not furnish them we shall pay the heavier price of insidious racial decay.

For a social philosophy of this sort the hope of a future state of society in which there shall be no more war and no squalid poverty, and in which individuals may live with comparative ease and comfort, freed from the hardships of an oppressive struggle for existence, is an idle dream. Fate has decreed that such things can not be, or at least, that they can not last. Has Mr. Kidd presented a faithful account of the actual operation of selective forces in human society? Though less obviously overdrawn than the picture given by Professor Haeckel, the presentation of the situation in "Social Evolution" is permeated by the same misconceptions and limitation of viewpoint. There was a tendency among earlier post-Darwinian writers, notwithstanding Darwin's warning to the contrary, to conceive of the struggle for existence in a too literal sense as necessarily implying rivalry, a sort of "Hobbesian war of each against all" resulting in the elimination of the weaker individuals. It was customary to look upon Nature as "red with tooth and claw" and to picture the struggle for existence as an active encounter of rival organisms in which victory came as the reward of strength or cunning. As a matter of fact a very large part of the selective elimination that takes place in the organic world is accomplished in a very peaceful and unobtrusive way. What may properly be termed rivalry, or the struggle of one organism with another, constitutes but a part, and in many species a very minor part, of the selective process. Organisms may survive by virtue of increased resistance, freedom from organic defect, or the possession of better adaptations to countless environmental agencies, without involving anything of struggle, except in a very figurative sense, of one organism with another. Doubtless the kind of struggle in which the success of one individual is based upon the failure of another, as in actual conflict or rivalry for food or mates, has played a very important rôle in the evolution of animal life, but, like other forms of selection, its incidence changes with circumstances. If it has tended to produce higher types of life among the animals below man, it does not necessarily follow that it will work in a similar way among civilized mankind. Natural selection may favor progressive evolution at one time

and degradation of structure and function at another. And we should therefore proceed with caution in applying our biological formulas from one group to another when we are dealing with problems of progressive development. How any form of natural selection operates under the complex circumstances of human civilization can not be decided *a priori*, but only by a careful study of its actual operation. It is quite possible, therefore, that the biologically novel conditions of civilized life may have involved such modifications of the workings of competitive struggle that its actual effects are very different from what they are in the lower animals.

To conceive of natural selection solely in terms of one of its methods of operation, that of competitive struggle, and to assume that competitive struggle is necessary for the progressive evolution of men, are two fundamental errors that are only too commonly found in the writings of the social Darwinist school. Upon these doctrines as a foundation has been reared more than one superstructure of social philosophy which has doubtless influenced in no small degree the international relationships of modern states. It is scarcely necessary to dwell upon the extreme importance of the deductions which might logically be drawn if the biological doctrines we have mentioned are of universal validity. We are only too familiar in these days with the policy and practises which a perverted Darwinism has been used to support.

Competitive struggle may take place between groups, or between individuals within a group. In intra-group rivalry, physical encounters have been all but entirely superseded by economic competition, and the latter seems to have increased as civilization has advanced. But competitive struggle within a group seldom leads directly to elimination, although it may give rise to conditions of life which cause an increased death rate. Those who are forced by this struggle into the ranks of the dependent classes, far from being extinguished, respond by an enhanced fecundity which more than offsets their increased death rate. As a result of forces peculiar to our social régime there has come to be established a biologically anomalous correlation between failure and fecundity which deprives of much of their force the pleas for the value of competitive struggle.

We may be told that the reason for the failure of competitive struggle is because we are too humane and extend the helping hand to too many who, in the interest of the race, should be allowed to perish. It is questionable, however, if the withdrawal of all organized and private charity would produce a

much higher death rate among the ill-endowed than occurs to-day. But whatever some writers might deem more favorable conditions for racial evolution, it is evident, I think, that the actual workings of competitive struggle are quite different from what have been pictured by most social Darwinists.

The deteriorating effect of unmitigated industrial competition has been clearly brought out by Prof. Karl Pearson in his criticisms of those social Darwinists who attempt to use the Darwinian theory of natural selection as an argument against socialism. While Pearson and his co-workers have attempted to demonstrate by statistical methods that natural selection is a potent factor in man as in lower organisms, the contention is made that it is not through the struggle of man with man for the necessities of life that its racial benefits are brought about. Conditions which entail a high death rate among the ill-endowed are apt to prove unwholesome to many others as well, and would therefore produce a general deterioration of the efficiency of the whole social group. A country in which a considerable proportion of the inhabitants are forced by industrial competition into conditions of squalor that sap the energies of mind and body, and in which a still larger part of the inhabitants suffer more or less injury from the severity of the struggle for existence, can scarcely compete on equal terms with a nation whose population enjoys a higher and more wholesome standard of living. A piece of mechanism which uses up a great deal of energy in internal friction is not an effective product. And a country which permits internal rivalries to waste its resources of human life is poorly equipped for any contest which may endanger its national existence.

In common with many militaristic writers Pearson attributes an important rôle to group selection whether it takes the form of actual war, or competition for markets, trade routes and spheres of influence. It is undeniable that this factor has been a potent one in the progressive evolution of man, but it is dangerous to conclude that it will continue to function in the same way under the peculiar conditions of our modern civilized life. Struggle of group with group has developed the instincts that make for mutual support and corporate efficiency; in a word, it has moulded man into a social animal. But our debt to this stern mother of altruism should not be taken as incontestable evidence that her services will always be indispensable.

Under modern systems of warfare it is not so much blood that tells as organization, training and equipment. Which of the warring nations of Europe is most favored by inherited en-

dowments is still far from being established. Practically all of them are mixtures of ethnic stocks to a degree that a racial analysis is well nigh impossible. And whatever the issues of the present war may be, there is no assurance that the inhabitants of the victorious nations will multiply more rapidly than those of the vanquished. Among civilized peoples war generally leads to the extension not of a people, but of power, policies and financial gain. A nation may be vanquished by war, time after time, as Austria has been during the nineteenth century, and at the same time increase in population, wealth and military strength.

Should wars be carried on to the extermination of the vanquished they might be justified on biological grounds, provided of course that the victors owed their supremacy to their innate superiority instead of to organization, equipment, discipline, numbers, or any of the other circumstances that commonly decide the issue between contending armies. To a certain extent it is perhaps allowable to assume that those peoples with the best endowment of intellect and character will, on the average, develop the most efficient preparation for war. Notwithstanding all that has been written from DeGobineau to Houston Chamberlain and Madison Grant on the innate superiority of this or that chosen people, the differences in culture and military efficiency among modern civilized nations are much more clearly traceable to extrinsic causes than to any factors which can be specified by the biologist. Russians and Servians retreat before well-drilled and equipped German armies for much the same reason that the ancient Germans and Gauls were unable to stand before the legions of the Romans. Nations march forward on the road to civilization at a very unequal pace. And history has repeatedly shown that the backward and relatively defenseless people of one era may prove to be the highly cultured and conquering nation of the next.

It is not to be inferred that civilized peoples have an equivalent inheritance. They differ quite evidently in temperament and instinctive bent, but, while they probably differ also in their intellectual aptitudes, we know too little on this score to distinguish the effects of hereditary from environmental factors. Any successful attempt to evaluate the innate mental differences of peoples would involve a thorough investigation by the best modern methods and on an extensive scale. As no such investigation has ever been made we have no very adequate basis for asserting which of the civilized peoples of the earth are the most highly gifted with inherited qualities.

It may seem very plausible to speak of the advantages accruing from the conflict of nation with nation and the consequent survival of the best endowed stocks. But even if the victory came to the peoples having superior hereditary qualities, it by no means follows that the vanquished would be supplanted by the victor. Should conflict result in placing a nation in a position of economic disadvantage such as would result if it were overrun by its conquerors who monopolize the positions of power and profit, the probable result would be that the conquered would outbreed their conquerors and regain through the cradle what was lost on the battlefield.

Under other conditions, however, where conflict leads to the expansion of a victorious people who replace the primitive inhabitants of the realm, or where industrial supremacy yields the material support for an increased population group rivalry may effect a racial advance. The Anglo-Saxon people have doubtless profited by both of these means. Conflicts with inferior races in so far as they prove to be directly or indirectly wars of extermination may lead to racial improvement, but the biological effect of war between civilized states is a much more difficult problem.

In view of the many considerations involved in such problems it is evident, I think, that the influence of group selection can not be determined *a priori* simply by the extension of a biological formula to human society. Group selection, like intra-group selection, may work in very different ways according to circumstances. Social philosophers who seize upon biological formulas and apply them uncritically, as they usually do, to the evolution of human society are apt to be led into very erroneous conclusions on matters of the gravest import. Just as competitive struggle between individuals may, under our present régime, give rise to injurious effects which more than outweigh its advantages, so may the struggle between groups lead to results quite at variance with what is commonly supposed to occur. We have become so imbued with the idea that the struggle for existence simply means that the weak go to the wall while the strongest and most highly developed come out ahead, that we lose sight of the ulterior consequences of the process, and especially the fact that the changes wrought by selective forces may be progressive or retrogressive as a multitude of attendant circumstances determine. It should always be borne in mind that the course which it is biologically most advantageous to follow is not infrequently the downhill path. Whether warfare, or any other form of group struggle,

leads nations along the path of progress, either biologically or culturally, is a question which can not be solved by abstract and general disquisitions on the survival of the fittest or the manifest destiny of superior peoples. It is a question which must be solved in each particular case by a thorough inductive inquiry.

Investigations of the biological effects of war have been few. It is scarcely to be gainsaid that in modern warfare the most vigorous and efficient suffer the greatest loss of life at the front, leaving the race to be continued by the less desirable parents who remain behind. But for the full determination of the biological effects of war we must pass beyond the effects of individual selection within the group to the biological outcome of the struggle of one group with another. One may contend with Steinmetz and Schallmeyer, who concede that military selection tends to destroy the best blood of the nation, but who maintain that the biological advantages of the victory of the superior forces more than compensate for this evil. Satisfactory proof of this thesis, however, demands much more critical work than that which has been devoted to the task. The studies of La Pouge, Ammon, and a few others who have attempted to investigate what the effects of group selection actually have been, have made little more than a feeble beginning of an undertaking beset with many difficulties and full of unexpected developments beyond the conception of most proponents of militarism. It is important to recognize that the imaginary solutions of this problem that have so long passed for the real ones and have been taken as postulates by such writers as Von Moltke, Steinmetz and Bernhardi in their attempts to justify war on the grounds of biological necessity have little support from inductive investigation. Whatever may be said in favor of war on other grounds, the biological argument is one of very dubious value, especially as applied to the struggles between modern civilized states.

If neither individual competition nor group selection has the unequivocal importance for racial progress that has been attributed to it, the consequences of social amelioration and exclusive devotion to the arts of peace may not, after all, be so disastrous, at least biologically. But if social evolution has so modified the operation of these factors that they can no longer be regarded as obviously making for race progress, to what must we look for further advance? Natural selection is doubtless still operating in various ways. We know as a matter of fact that some hereditarily degenerate types are on the average short-

lived, and that strains with a diathesis to certain diseases tend to die out. Several of the studies on natural selection in man, especially those dealing with the racial influence of infant mortality, have yielded results about which there has been considerable controversy. To ascertain just how natural selection is operating among human beings is a problem involving many technical difficulties that often tax the abilities of the most expert biometrician. There can be little doubt, however, that the intensity of natural selection has been diminished through the advances of medical science, and that it will continue to decrease with the improvement of the conditions under which people live. In some respects this diminished activity will be racially bad, but if social amelioration should bring about the abolition of warfare and equalize the birth rate so as to check some of the prevalent evils of differential fecundity it is not improbable that the net result would be advantageous.

There is one factor in our problem which we have not yet considered and which, despite its very great importance, has been almost entirely neglected in considering problems of human evolution, and indeed problems of evolution in general. This is the question, How does the changing complex of environmental forces which is brought about by social evolution affect the kinds of variations that are produced as material for the action of selective forces? It is obvious that if hereditary variations did not arise from time to time, selection would be unable to accomplish anything. It is equally obvious that whatever selection can accomplish is conditioned upon the kinds of variations which are offered for its choice. The selective breeder would never be able to create a race of six-toed cats unless an occasional kitten with more than five digits should happen to present itself. No breeder of plants would try to produce a grass with divided leaves because no trace of such a variation has ever been known to occur in human experience. Natural selection must take what has arrived as a basis for what it may succeed in building up. It is like a builder who employs the stones fashioned for him by some one else, and whose choice is limited to using or rejecting what is supplied to him. A builder could never erect a marble palace if his materials were limited to a varied assortment of cobble stones. And natural selection could never produce anything not already fashioned beforehand by those forces, whatever they may be, that determine the nature of hereditary variations.

What causes hereditary variations to arise in organisms is a subject about which we know almost nothing. One can

number on the fingers of one hand the investigations of any importance that deal with this problem. Beyond the fact commented on by Darwin that changed conditions of life tend to enhance variability, very little was known about the production of variations through environmental changes until the experiments of Tower showed that in the Colorado potato beetle a high temperature and an unusual degree of humidity during the period of maturation of the sex cells resulted in the production of well-marked mutations which bred true to type. The stability of these new mutations indicated that they owed their origin to changes in the germ plasm brought about by changed external conditions. In the evening primrose, *Oenothera lamarckiana*, and a few other plants stable mutations have been produced by the action of chemicals injected into the ovary, and by treating the plants with rays emanating from radium.

The experiments thus far performed afford a certain amount of evidence for the conclusion, to which one would naturally be disposed on *a priori* grounds, that the kinds of variations that arise in organisms are conditioned by the nature of environmental forces. If this be true, we are naturally led to enquire how the changing environment to which civilization exposes the human race affects the trend of variations that arise in the germ plasm. With our unnatural indoor life, the unwholesome living conditions of a large part of our wage-earning population, the increasing drift of people into large cities, our alcoholism, and our numerous diseases, it can hardly be expected that the germ plasm of the race will escape being affected in some way. But how? Here we are compelled to confess practically complete ignorance. Were we to judge by analogy with what has happened with our domestic animals, which are relatively degenerate from the standpoint of physical vigor and general intelligence, the probable outcome would not be reassuring. We might be disposed to infer that germinal variations arising in response to agencies which impair the vitality of the body would probably give rise to inferior progeny. The disastrous effects of lead poisoning upon the children of workers in lead, even when the father alone is affected, may be an indication of the kind of influence which might be anticipated from the action of an unwholesome environment. We know too little, however, of the permanence of the transmitted effects of lead poisoning to base anything more than a very tentative supposition on these results.

With regard to the important question of the hereditary in-

fluence of alcohol our knowledge, although still very unsatisfactory, affords some ground for more or less probable inference. While statistics show that epilepsy, insanity, and feeble-mindedness occur with much more than average frequency among the offspring of parents addicted to alcohol, this correlation may be due to the fact that parental alcoholism is so often the result of a neuropathic constitution, and that it is the inheritance of this constitution, and not the effect of parental intemperance, that disposes the children of alcoholics to various forms of nervous malady and mental defect. Statistics may discover correlations but they are seldom adequate for establishing causal connections. As the method of experiment to which recourse must usually be had in the endeavor to ascertain causes can not well be applied to human beings, the most promising field of enquiry is afforded by experiments on animals. If alcohol were found quite generally to produce hereditary defects in animals, we should have a strong argument in favor of its producing similar results also in man.

Of the investigations that have yielded indications of the injurious hereditary effects of alcohol, the recent work on guinea pigs by Stockard and his colleagues is the most noteworthy. The animals employed were bred and shown to be capable of producing normal offspring before they were subjected to the influence of alcohol. Control experiments with untreated animals were also carried on side by side with animals to which alcohol was given, and the offspring of the two sets carefully compared. Without describing the methods of experimentation or giving the details of the results, it may suffice to state that the alcoholized guinea pigs gave rise to a much larger proportion of still-born offspring and offspring which lived but a short time than did the controls. It is particularly noteworthy that when the male parent alone was given alcohol the percentage of defective offspring was strikingly large, although the largest proportion was obtained from the matings in which both parents were alcoholized. It was further shown—and this is particularly significant in relation to our problem—that when the offspring of alcoholized parents were bred without being subjected to alcohol they gave rise to a large percentage of defective animals. Deformities such as an eyeless guinea pig, animals with a reduced number of digits, dwarfs, and many other kinds constituted 5.23 per cent. of ordinary alcoholic strains, and 14.81 per cent. of inbred alcoholic strains, while no deformities appeared among the animals bred from normal parents.

These experiments, unlike most previous studies, were car-

ried out on an extensive scale and with due checks and controls, and they seem to afford strong evidence for the conclusion that alcohol administered to guinea pigs gives rise to defects in the progeny which are capable of being transmitted to subsequent generations. Recently Pearl has applied Stockard's methods to the domestic fowl, but instead of obtaining evidence of inherited injury he found that the progeny of the treated birds were slightly above the controls in fecundity and apparent vigor. These results are not necessarily inconsistent with those obtained by Stockard, since the germ plasm of the fowl may be much less easily affected by alcohol than that of the guinea pig. Further experimental work on this important topic is much to be desired before we can be entirely justified in drawing conclusions concerning the hereditary influence of alcohol in man. At present, all that we are warranted in inferring is that alcoholism in man is a more or less probable source of hereditary defect.

The same guarded conclusion should be drawn, I believe, in regard to other so-called "racial poisons." The terrible consequences which luetic infection entails upon following generations are primarily due to the transfer of pathogenic germs from parent to offspring, instead of to heredity in the proper sense of this term. Nevertheless, it is a distinct possibility that the toxins carried in the bodies of the unfortunate victims of this common malady may injure the germ plasm in such a way as to give rise to strains with a true hereditary defect. We may have similar suspicions that the same result may be produced by tuberculosis and other diseases; but unfortunately in regard to most of these questions we can only indulge in speculation. Did we know what agencies give origin to our strains of imbeciles, lunatics and morons we might be able to nip in the bud one of the most serious of our social evils. We may have a shrewd suspicion that our modern régime with all its institutions which conspire to sap the vitality of the race is continually adding new strains of such undesirables. When experiments on the causes of variability in the lower animals have yielded us a large body of well-organized knowledge, instead of the meager and scrappy information which we now possess, we shall doubtless be in a position to draw conclusions of a high degree of probability regarding the trend of variability in man, and possibly to bring this variability in a measure under control.

Any consideration of the influence of social amelioration upon the evolution of racial qualities has to take into consideration the question of how the trend of variation in human

beings will probably be affected. If, as seems not improbable, intemperance, disease, and possibly bad living conditions are productive of hereditary defect, our racial welfare may not be seriously menaced by the reduced action of selection which would probably follow upon the institution of social and economic reforms. On the contrary, the race may be freed from sources of continued contamination which act as a check upon its progress. A social system which presumably favors the "beneficent working of the survival of the fittest" by creating conditions of life that lead to a high death rate among the less successful types, may not only fail to eliminate these types, as we have attempted to show, but may be a means of actually creating the inferior variations which it is supposed to destroy.

Our aim thus far has been to show that the realization of Utopian dreams of a state of society in which the evils of poverty, intemperance, severe individual struggle and warfare have been relegated to the past does not necessarily entail biological decadence. In fact, there are reasons for believing that such a consummation would do away with many of our present sources of racial deterioration. Would it also set into operation any agencies which would promote racial advancement?

If the cure for democracy is more democracy, it may also be true that the cure for the cure for the racial evils of civilization is more civilization. An enlightened society, possessing a knowledge of the principles of its own evolution, and mindful of the welfare of future generations, may accomplish much in the direction of eugenic progress. The control of the birth rate which mankind is now exercising from prudential considerations, or the more laudable motive of giving better advantages to a few children rather than mere maintenance to many, might, in such a society, be utilized more for social and less for individual ends. With parenthood placed upon a voluntary basis we might reasonably expect that the less desirable stocks would show an increased tendency toward elimination and that the rearing of children would be undertaken in greater measure by the classes more amenable to the influence of the sense of racial obligation.

Alfred Russel Wallace entertained great hopes of race improvement through the financial emancipation of women. When women are no longer tempted to marry for support they will, according to Wallace, be more apt to select only superior types of men to be the fathers of their children. As a means of race improvement doubtless marriage selection has magnificent possibilities. But when we reflect upon the frequency

of marriage among the Jukes and Kallikaks on the one hand, and the low marriage rate of women graduates of colleges on the other, it must be admitted that, as a factor in race progress, marriage selection at present is a miserable failure. Mere economic reform can not be relied upon to improve matters greatly unless it is accompanied by a general diffusion of education; and education will avail little unless it includes the inculcation of a sense of responsibility for the hereditary qualities of future generations. Education is eugenically of value chiefly as affording a basis for the development of a "eugenic conscience" which is now sadly lacking in most people of culture. It is a hopeful sign, however, that here and there among people who have inherited a generous measure of desirable traits eugenic considerations have led to the rearing of larger families. One is therefore encouraged to have sufficient confidence in human nature to believe that the spread of eugenic education, so that people of superior endowments will have the matter of their obligations to the race brought squarely home to them, will not fail to have an effect in checking the evils of our present differential fecundity.

Racial improvement has doubtless very intimate relations to the improvement of the economic conditions which now oppress a very large proportion of mankind. A society with well-marked castes will probably make little progress if it includes an ignorant and poverty-ridden proletariat. Under a régime which affords better educational advantages and a higher standard of living for the less successful classes, the relatively high birth rate of those who multiply through sheer lack of restraint would probably be reduced. Economic reform is by no means the panacea for racial and social ills that it is apparently taken to be by many socialistic theorists, but it would afford conditions under which the operation of eugenic ideals would doubtless be more effective than under our present social order. Greater equality in the distribution of wealth would tend to bring about greater equality in the birth rate of different classes. With a higher general standard of education and a diffusion of the sense of obligation to transmit socially valuable qualities to future generations, conditions might possibly be changed so that a greater relative fecundity would come to characterize the more vigorous, intelligent, and public-spirited members of the community. Should society succeed in restoring the correlation between fecundity and the possession of superior qualities—a correlation which our present civilization has pretty effectually subverted—humanity would once more be on the highway of racial advance.

THE LOCALIZATION OF INDUSTRY

HOW IT STARTS; WHY IT GROWS AND PERSISTS

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“PILL-ALLEY” is the college slang for a certain stately elm-arched street lined with colonial mansions. The name “Pill-Alley” is a recognition of the large number of doctors who live along that one avenue. The old college town is by no means the only place that shows evidence of the singular tendency for professional men to hang their shingles one beside the other. Nor is this peculiarity confined to the professions, for a similar liking for the neighborhood of their rivals is shown by retailers, wholesalers and even by manufacturers. Dentists as a rule hive in one office building, opticians open their shops along the same thoroughfare, department stores crowd about some one vantage point, wholesale leather dealers jostle each other in their neighboring warehouses, and wholesale wool merchants congregate near a common marketplace. Manufacturers, too, show the same tendency. More than three fourths of the collars and cuffs made in the United States come from Troy, New York; silver plate to a like degree is manufactured at Meriden, Connecticut; tanning is centered at Milwaukee, Wisconsin; and Paterson, New Jersey, is the home of silk manufacturing. So the story goes; a large number of the great and small industries of the United States are not scattered broadcast over the entire country, but are confined to one narrow locality. This fact is contrary to what common sense would seem to dictate, for apparently a business would be most assured of success where it had no competition in the immediate neighborhood, but in reality industry seems to thrive best where it throngs most. It is worth while, then, to find out how localization starts and grows, and what advantages it offers.

Some localized industries have started as a response to resources either in raw materials and power, or in unskilled labor. Others originated in particular places because they were near to their market, while a few by virtue of a monopoly control were permitted the choice of a desirable strategic location.

The presence of raw materials has been a potent factor in giving rise to localization. For example, Chesapeake Bay is

the greatest bed for oysters to be found in America, and, as a result, the metropolis of the Bay, Baltimore, does more than two thirds of the oyster-canning business of the United States. One might generalize and say that, as a rule, the preserving industries localize near the source of their materials. This explains the salmon canneries of the Columbia River, the wine plants of California, the grape-juice factories of northeast Pennsylvania or northwest New York, the sweet-corn canneries of Maine, the tomato canneries of New Jersey and the slaughterhouses of Chicago.¹

Not only perishable raw materials, but also those that are bulky, heavy or fragile, tend to collect factories near the point of origin of the crude stock. Thus Pittsburgh, near the fragile coke of Connellsville, manufactures with this fuel eight per cent. of America's rolled steel; likewise in the Lehigh Valley heavy rock is transformed into the Portland cement used to build skyscrapers in New York and Philadelphia and other cities along the Atlantic coast. Similarly Muncie, Indiana, near to abundant supplies of natural gas for fuel, is one of the largest national centers of glass-making. The fruit jars known by housewives all over the United States are manufactured there. Accordingly, in many different places raw materials of various kinds have been responsible for the fame of a locality in the industry that reshapes those raw materials into a more serviceable form.

It has frequently happened that industries called to particular places by resources in materials have remained where they started long after the local supply of crude stock has disappeared. The rubber-using factories of Massachusetts, Rhode Island and Connecticut may be taken to illustrate the point. In young America, when commerce was a source of large profit, many curious products from out-of-the-way regions of the world were carried to New England ports. Among other commodities, rubber from the Amazon entered Boston, Massachusetts; Providence, Rhode Island; and New Haven, Connecticut. The presence of this raw material gave rise to rubber-using industries in or around all three of these cities, the goods made ranging from overshoes to fountain pens. Yet crude rubber is seldom seen to-day on the docks of these maritime cities, for most of it now comes into the United States by way of New York. Despite the fact, nearly all the rubber overshoes, boots or arctics made in the United States are produced in the locality between Providence and Boston, because this was the *original*

¹ Thirty-three and one third per cent. of the nation's slaughtering is done at Chicago.

region of import. A half-dozen plants now belonging to the United States Rubber Co., as well as the factory that turns out Waterman's fountain pens, are all in one narrow valley adjacent to New Haven. The Woonsocket Rubber Company is within hailing distance of Providence, while the Hood Rubber Company is representative of scores of others that girdle Boston. Likewise the plated-jewelry industry centered in the Attleboroughs of Massachusetts, just outside of Providence, Rhode Island, is there in response to the fact that gold and silver from Spain, Portugal and the West Indies once were borne into Providence by home-bound commerce carriers. Since the European war opened, attention has been called to the predominance in firearms manufacture of three Connecticut cities; namely, Bridgeport, New Haven and Hartford. These cities are now famous for rifles and revolvers because at one time western Connecticut produced a grade of iron from local ores that was better fitted than that found anywhere else for making weapons or edge tools. In all of these cases, the rubber mills, the jewelry factories or the firearms plants, the present-day greatness of the industries entirely overshadows the fact that they came to the regions originally because raw materials were easily secured at those points.

Water power is a resource that is responsible for drawing many industries into compact units around desirable power sites. Accordingly, we find that one third of the knit underwear made in the United States is furnished by a string of towns in the Mohawk Valley from Cohoes to Utica. This is due to the circumstance that the first knitting machine run by power was set up at Cohoes to take advantage of the large amount of power available at that place. American writing-paper manufacture centers at Holyoke, Massachusetts, because the reduction of rags to pulp requires a large amount of power, and the Connecticut River at Holyoke furnishes the greatest water power in New England. The falls and canal systems at Holyoke fixed the attention of engineers upon water-propelled mechanisms, and out of their studies improved turbines arose. As a consequence, Holyoke entered the field of machinery manufacture, so that later when Niagara was bridled, the great turbines that turn Niagara's energy into usable power were made at Holyoke.

The large number of rapids and falls in the Merrimac River attracted to its banks the largest cotton mill in the world at Manchester, New Hampshire, the largest wool mill in the world at Lawrence and one of the principal cotton manufacturing

cities of the United States at Lowell; no other stream in the world turns so many textile spindles as the Merrimac. Power then, as well as raw materials, is responsible for the origin of many localized industries.

An unused labor supply also frequently calls together a group of mills to take advantage of the opportunity to exploit this labor. Wherever an industry has collected a large working force of men, a situation favorable to industries using female labor is created because the wives, sisters, daughters or cousins of the male workers are glad of the chance to get a job whereby they may increase the family budget or attain individual economic independence. Hence silk mills have invaded the coal-mining districts to such an extent that Scranton, Pennsylvania, is second only to Paterson, New Jersey, in the manufacture of silk. Allentown, Pennsylvania, in the Lehigh Valley cement district, ranks abreast of Scranton in the silk industry because cement-making employs the men of the family while the silk mills give occupation to the women or girls. Industries of this sort are called parasitic because they utilize a labor force collected by some other activity.

It is apparent that some localized industries originated in a resource, or in an unused labor supply. Others have started because a large market near at hand gave the necessary incentive. The potency of a market in establishing a localized industry is seen in the case of the manufacture of agricultural implements. This industry has followed the grain belt westward; once along the Atlantic, then in interior New York and now in the middle west, manufacture and market have always coincided. Starting in Chicago, because that city has easier access to all the great agricultural states of the upper Mississippi valley, the industry has so expanded that to-day Chicago can claim a fourth of the entire nation's product.

But more than resources, more than labor, more than markets, more than any other cause for the start of a localized industry, we must recognize the power of chance. Fortuitous accident has been responsible for the feeble beginning of now strongly entrenched industries more than any other reason we may assign. Westfield, Massachusetts, now manufactures over two thirds of our whips because one irate farmer, incensed by his neighbors' pillage of his willow hedge to belabor their horses, cut the willows himself, bound them with twine and sold them to the erstwhile plunderers. That started an industry that has since made the town conspicuous. The position of Lynn in the shoe industry, the center of a circle of towns manu-

facturing a fourth of the shoes worn in the United States, is partly due to the chance settlement there of a Welshman named Dagys, the most skillful shoemaker in the colonies. If Dagys had happened to go to Providence or New Haven, doubtless one of these cities rather than Lynn would now have Lynn's honorable station. German Palatinates, fleeing to America, but skilled in the art of knitting, by chance found congenial religious refuge in Penn's settlement of Philadelphia. Once established on our soil, they set about their accustomed trade and soon made Germantown (part of Philadelphia) famous throughout the colonies for its stockings. To-day, as a result, Philadelphia manufactures more hosiery than any other place in the country. So the list of illustrations might be lengthened, but it would prove only more conclusively that accident is the most influential factor in determining where a localized industry will come into being.

One other factor, however, must be mentioned; namely, monopoly. In modern industry we are familiar with the spectacle of one corporation or group of allied companies gaining such ascendancy over the whole trade that arbitrary decisions replace the usual give-and-take of competition. The will of one compact unit becomes the law for the whole industry. It is obvious that such a monopolistic control may choose the most desirable locations for its plants, and concentrate its efforts in a few most advantageous places. The limitation upon the number of factories and the large output in a few selected towns or cities bears a close resemblance to localization of industry. For instance, all of the oil-refining done in America is carried on in a half-dozen great plants, some on the Atlantic coast, some in the Central West, and some along the Pacific. Similarly, sugar-refining is confined to a few strategic points. The manufacture of shoe machinery is likewise confined to one town (Beverly, Mass.) in the heart of the greatest shoemaking district. In every case, the localization is entirely artificial and could be annihilated by an adverse court decision or the expiration of patents. Before the Standard Oil Company gained its supremacy, there was no localization of refineries; the American Sugar Refining Company is responsible for the localization of its industry, and if there were no United States Shoe Machinery Company, every machine-tool center in United States would have the possibility of entering that trade. So localization induced by monopoly is only as permanent as the parent corporation that gives it birth. It is undoubtedly economic and profitable, but if competition were given full sway, monopoly-localization could not endure.

Whatever was the cause of their inception—raw material, power, unused labor, a nearby market, accident or monopoly—all localized industries have shown similar methods of growth, have profited by like advantages and suffered by reason of analogous handicaps. How a localized industry grows is a more important consideration than how it starts.

Many industries have become localized because they are family affairs, and the family has remained in one section of the country. A father in business with several sons often establishes those sons in branch plants or associated lines, which, growing to prominence around the original plant, give a reputation to the locality for that particular business. The cotton industry of southeastern New England has always been associated with the names of Slater, Borden, Sprague or Knight; the cotton manufacturing of the Merrimac River is intimately connected with the Lawrence family, while at the present time Chattanooga, Tenn., is developing into a cotton-mill center under the leadership of the Thatcher brothers and sons. In colonial America, no iron-making project was said to be complete unless a Leonard was in control, and the great brass industry of western Connecticut is the outgrowth of the Scoville, Benedict and Burnham families.

By means of shop association as well as through blood bonds, an industry increases in importance in the town where it first starts. Superintendents or foremen may be considered as members of an "industrial family" just as sons are the heirs of their fathers. When an experienced superintendent decides to become his own boss, oftentimes he finds it impossible to go to a strange place in which he is unknown; but in the town where he has worked for years, the bankers know and trust him, and the business he purposed to enter is a tested proposition. Consequently the superintendent can best succeed by establishing himself in the shadow of the plant where he was once an employee. It has been stated that every cotton mill started between 1790 and 1814 was by men who themselves had been trained by Samuel Slater, at Pawtucket, Rhode Island. Growth of this kind, through former workmen, has made Attleborough the seat of plated jewelry, and the Mohawk Valley the chief center for the manufacture of knit underwear.

Timidity of local capitalists is another cause for an industry's enlargement in a particular place. Many men with small amounts of money to invest are afraid to risk their funds in any project unless they can keep it under daily observation. Hence, they encourage new ventures in their own town as long

as there is promise of profit. When New Bedford whaling captains saw their own business declining, they looked for a new opening for their financial resources. Their close neighbor, Fall River, was making great strides in cotton manufacture but the old whalers absolutely balked at furthering enterprises in another town. Instead they put their money into cotton factories in New Bedford with the result that to-day New Bedford stands second in this industry and holds first place for quality.

Sons, superintendents or local capitalists promote the early growth of an industrial center, but the mature advance is occasioned by the multiplication of allied industries, the increase in the number of supply houses or by the presence of plants utilizing wastes.

Instead of attempting to manufacture an entire shoe, many plants in Lynn or Brockton confine themselves to making heels, counters, box-toes or soles; similarly in Lowell, New Bedford, Philadelphia and other textile centers, there are enterprises that specialize in originating patterns or designs, others which prepare warps for looms and yet others that produce spools or cops to hold threads. Ventures of these kinds would meet with little success if they were attempted anywhere but in a community where the main industry was localized, because the expense of reaching a market would exhaust all profits. On the other hand, the presence of shops specializing in parts of the main product aids the larger factories, for it enables them to purchase supplies right at hand. The way in which a subsidiary industry is correlated to the principal one is familiar to every one in the case of automobile manufacture.

The greatest source of automobile accessories is Detroit, which is also the largest producer of automobiles. The association of major and minor plants may also be seen in the textile industry. Philadelphia, one of the chief textile centers of United States, has more dye-houses than any other city. In fact the close union of independent and dependent mills is one of the most striking features of our manufacturing industry. About two thirds of the needles and pins of American manufacture come from Connecticut, the state that supplies the brass of which needles and pins are made. The home of the sewing machine is Bridgeport, Connecticut; corsets, almost entirely a sewing-machine product, come from Bridgeport,² and New Haven.³

² Twenty per cent. of the United States total.

³ Twelve per cent. of the United States total.

The large and small enterprises at the chief seat of an industry are a benefit to each other because by subdivision of product and by greater specialization, the costs of production are reduced, so that outside competition is easily met. Partly finished material is also produced at the very doors of the factory that will complete it for market; hence transportation charges are reduced and annoying delays in delivery obviated. Therefore, an industry once established in a locality is assured of a steady advance.

Localization, furthermore, attracts to itself plants whose business is the utilization of waste products. In order to insure a plentiful supply of raw material upon which to work, these shops must be where there are many factories creating the same sort of waste. For the factories, the presence of the waste-using shops turns a loss into profit, a charge into a credit or a liability into an asset.

An instance of this form of economy may be witnessed in the iron and steel industry. The largest steel mill in the United States at Gary, Indiana, has its complement in a great cement plant at Buffington, Indiana. The cement is manufactured from the slag that the steel mills throw out. Slag is the scum of impurities taken from the ore when iron is smelted. Ordinarily it has no value, but is one of the greatest nuisances to clear out of the way. It so happens, however, that slag usually contains sand, clay and lime, the three materials that compose cement, so that by grinding the slag and mixing the three constituents in the correct proportions cement may be manufactured. A cement plant corollary to a steel works, therefore, is a great boon to the steel concern, because by making cement of slag the premises of the steel mill are rid of the accumulation and at the same time what would otherwise be more than a loss is turned into a revenue producer.

Another illustration of the utilization of waste is seen in New York City, the nation's tailor shop. The short ends of cloth are carried to the cap shops that are usually next door to clothing factories. If there were no adjoining cap factories, the only market for remnants would be a shoddy-mill, but as a raw material for caps, the scrap cloth is more valuable than in the form of rags destined to shoddy. The arrangement is advantageous to cap makers, too, because it saves a large amount of cutting, and allows a wider range of cloth patterns than the manufacturer could afford if cloth were purchased in the whole piece.

Again, the city of Gloucester, Massachusetts, is one of the

most famous fishing ports in the world. In preparing fish for sale, the heads and tails are removed. These are not thrown back into the sea, but are carried by the dray-load to a factory that is famous all over the country as a producer of glue and mucilage.

Waterbury, Connecticut, also, around which city a half of America's brass is made, has a "brass laundry" where small pieces of scrap and shavings are washed to recover the machine shop oil, to separate brass from other metals and to make the recovered brass available as raw material for recasting. This "laundry" handles twenty million pounds of brass shavings per year and adds a value of five to fifteen cents per pound.

Whenever such waste-using plants appear, they add an increment to the importance of a locality as the center of an industry; for by transforming liabilities into assets, and turning costs into profits, they aid in the defense of the community against the onslaughts of outside competition. Hence they augment the growth of the industry in the location where it is already rooted.

Frequently it happens that after a town has become thoroughly identified with an industry, its name has such an advertising value that new concerns seek it instinctively in order that the weight of the prestige of the place may bolster their own reputation. Detroit is the Mecca for incipient automobile manufacturers; the name Brockton lends quality to a shoe because Brockton has the reputation for men's high-grade footwear; New Bedford likewise stands for high-quality cotton; indeed the name of some of her mills is the recognized symbol of certain grades, for example Wamsutta sheeting. The multiplication of small plants attracted by the mere name of a town adds to the renown already attained by the community.

But what is the secret for the success of plants that swarm into one place, fiercely competing with each other and watching, hawklike, for each advantage? How can they profit in such close union?

One of the principal outstanding facts in regard to localized industries is that almost without exception they depend upon highly skilled labor. This circumstance helps to account for the paradoxical prosperity that attaches to the place where the large number of plants makes trade rivalry most vigorous.

An adequate supply of labor especially trained for the work to be done is the foremost advantage enjoyed by the individual units that comprise a localized industry. If one plant desires to expand it can draw upon the reservoir of labor already

created. All the factories in the town are constantly filling this reservoir because each mill is a training school for the others. The young boys upon leaving school follow in the steps of their fathers. They learn by actual experience in the factory the moves peculiar to the particular industry; and at home, on the streets or at recreation, imbibe the secret "rules of thumb" current among the workmen and known only to them. The very atmosphere seems charged with a mysterious power that the men draw upon to further the efficiency of their labor, a force which is lost in a city whose industries are largely diversified. The whole accumulation of skill is at the beck of the firm which needs it, and in an industry where trained men are required, its value is beyond estimate. The greatest resource, for example, that the commonwealth of Massachusetts possesses is her abundant supply of skilled men and women, collected in various localities where special work is being performed. The contrast with a state like Pennsylvania is made plain if we suppose some awful catastrophe to sweep away all the people of both states. After such a calamity Pennsylvania would arise again in power, for her coal, her natural gas, her iron, and her agricultural sections—such as Lancaster County, famous for its farms—would bring a new population to work these natural resources; but Massachusetts would be dealt a blow from which she would never recover, because her greatest asset would be wiped out of existence, and instead of being a commanding industrial state, she would probably be known only as a summer resort. Skilled labor, then, is the basis for her wealth, and this resource is nursed and conserved by localized industries. Inasmuch as trade secrets and tricks of manipulation are handed down from father to son, and from friend to friend, there is a social heredity of skill transmitted from generation to generation. Newcomers are easily absorbed in the all-enveloping trade in its home place, but manufacturers who have attempted to draw away even the most highly trained individuals to act as teachers in another remote city have met with failure after failure because the *group* was not skilled and had not known the trade from childhood. The group skill found in a localized industry is the reason why the industry clings to one small section of the country; it is the greatest single advantage that employers find when they set up their plants where others have thriven for years.

Skilled labor differs radically from unskilled in its mobility. Skilled men and women dislike to move from the town where they have settled. They have made many social or economic

ties that are hard to break; their friends and relatives live in the town; their fathers and mothers perhaps are buried there, they own their homes there, and have small investments in other land or maybe in the industries of the town. Hence, it means uprooting a whole life to wrench a skilled laborer away from his home town. Since so many localized industries employ skilled laborers, and inasmuch as the industries are vitally dependent upon that labor, they perforce must stay where the labor has become knitted to the locality. Quite a contrary case exists in regard to unskilled labor. This kind has no deep roots in the soil of a place; their interest is primarily financial—the pay envelope—and not social. Hence unskilled labor may be shifted from town to town with the utmost ease. This helps to explain why industries employing unskilled labor are not localized, while skilled industries are highly concentrated in particular communities.

The visible supply of labor at work in the factories is not the only advantage a localized industry offers to mill owners, for there is a secret benefit which grows out of localization, namely, the ready rapid expansion of the labor force during rush seasons by means of home work. We talk about our times as the "Factory Era," yet one half of the people⁴ employed in producing wearing apparel, jewelry, silverware, paper articles, sporting goods and celluloid ware, are never housed within factory walls, but do the work in their own rooms. In Massachusetts, for illustration, home work is not confined to large cities, to tenements or to foreigners, nor is it an unofficial pittance to the poverty-stricken; on the contrary, the greatest number of home workers have a family income ranging between \$750 and \$1,500 a year. The tasks are performed largely by women about thirty years old who have formerly been wage-earners, but are now married and tied to their homes by children, yet glad to do little jobs to earn "pin money"⁵ at times when their hands would otherwise be idle. Manufacturers are delighted to avail themselves of this labor force, for it makes no extra demands on the employers, nevertheless enables them to get out orders on time. It is their safety valve⁶ since the factory force may be kept intact while the number of operatives outside the walls swells and contracts with the demand for the products. Wherever the home work necessitates some skill or previous training, the manufacturer is well nigh compelled to

⁴ Mass. Labor Bulletin No. 101, Industrial Home Work.

⁵ They earn about \$100 a year.

⁶ Or the "marginal element in labor force," to use economic terms.

locate his plant where the labor lives, if his product is subject to the whims of fashion or to seasonal variations. We can appreciate why fourteen of the twenty-eight comb factories in Leominster, Massachusetts, give out home work; why it is that in jewelry manufacture 74 per cent. of all employees are outside the factory roof; why almost all women's neckwear is made in homes, and why, even in so thoroughly mechanical an industry as shoe-making, the bows for shoes and the beading for slippers are made and attached in private dwellings. A large amount of home work is also carried on in connection with the collar factories of Troy, New York; and glove manufacture in all its stages, in Gloversville, New York, is frequently conducted upon the workers' own premises. Hence in all localized industries we must add the invisible trained labor force to that which is in plain sight in the factories; the two together form a combination whose advantage no employer can overlook. Yet there are other advantages to be found in a community whose energies are devoted to one product. Among them are the facilities offered for buying and selling.

In a localized industry small concerns may buy together and thus gain the advantage of bulk shipments, which in the course of a year would represent considerable saving. Freight rates are apt to be lower too, where there are many concerns purchasing the same sort of raw material, because the railroad will equip itself to handle the variety of freight in which its customers deal. By cooperation, the cotton manufacturers of New England have been able to secure such low commodity rates on cotton shipment that whereas formerly much of their raw material was shipped to them by water, it now comes entirely by railroad.

In selling, it is easier to dispose of wares in the vicinity of others who are doing the same thing, because a market is established to which prospective buyers come. This is the reason doctors, dentists and department stores locate where there are other doctors, dentists and department stores. A new concern can not afford to forsake the involuntary aid extended by its neighbors in the same business. Together they constitute a center to which purchasers come; separated, each concern would be forced to put forth a strenuous effort to attract buyers to its doors.

The creation of a market within a localized industry leads logically to the result that some portion of the community devotes itself more and more exclusively to the marketing side of the business. In England, Manchester is less a cotton-mill

town than it is a warehouse city, where raw materials are collected for the cotton mills in nearby Bolton or Oldham, and where the cloth from those mill towns is sold. Leeds holds a similar position in respect to the iron trade of England. In Massachusetts we see a like tendency in that Boston is the warehouse for the shoe industry on its border, and in New Bedford, the old city at the center is taking over the commercial business of the cotton mills in the new developing cities at each end of the township. New Bedford really contains three cities under one name, two devoted to manufacture, one to trade. Worcester holds an analogous position for the textile mills of the Blackstone River valley, and Providence, Rhode Island, for the jewelry industry of the Attleboroughs. The cause for the segregation of the market is two-fold; on the one hand it is due to unusual transportation facilities at one part of the district in which an industry is localized, and upon the other to increasing rents at a center driving factories to the rim and leaving the heart to offices which take up little space. These central places, too, offer advantages for buyers to congregate. Aside from railway or hotel accommodations, it is easier for buyers to visit a series of warerooms close together than it is to travel from mill to mill, although the mills may all be in one district. Wherever an industry has become sufficiently developed in one locality to bring forth a central market for buying and selling, the advantages of the localization are greatly increased, since a well-defined place of bargain and sale secures more trade than would a number of scattered offices.

Not all the advantages of localization are on the side of the employers, for the employees too gain by dwelling in a city where there are many factories where men of one trade are employed. For instance, a man who is a cotton weaver stays where weaving is done in several factories, because if he loses his job in one he may be able to get a place in another. Likewise immigrants or weavers from other states will seek the town where weaving is a well-known occupation, because they have a chance of obtaining employment at the thing they know best. Consequently in a localized industry there is greater security of job for laborers than in a town where there is only one factory of a kind.

Where there are many people engaged in the same tasks, a labor union is much easier to form than in a community in which there is only one factory of any one particular type, unless that one plant is exceptionally large. A skilled man or woman fares better in a place where there are many others who possess the same kind of skill, since all can make their demands

felt by acting in agreement. The cotton-mill workers of Fall River have formed unions, with the result that, although they constitute but a small fraction of the total number of wage-earners in the industry, nevertheless they set the wages for the whole group in New England. In concerted action there is strength.

To both employer and employee, therefore, localization offers many advantages, but it also has deterrent features that detract from the favorable picture we have drawn; there are shadows as well as high lights.

Chief among the disadvantages is the distance separating the industrial center from the consuming market. As we have mentioned before, buyers tend to seek the community in which an industry is localized, but these men represent wholesale houses, jobbers or large mercantile establishments, most of which of necessity must be far from the town where the goods they purchase are produced; consequently the public to which the wholesale men cater is a long way from the factories. For illustration, products manufactured in Massachusetts must be transported often half the length or the breadth of the country before they reach the individuals who actually use them. This long carriage adds freight charges to the cost of the articles that become so burdensome that an effort is made to produce the things needed nearer the point of consumption. It was for this reason that shoe factories were first set up in St. Louis, and the advantage of being nearer the market than Massachusetts has fostered its growth as a shoe center until it ranks as the third most important one in the United States, only Lynn and Brockton surpassing it, and Haverhill trailing in its wake. All the other recognized wholesale cities tend to establish shoe factories for the same reason that St. Louis secured them; thus they are becoming familiar sights in Philadelphia, Chicago and Cincinnati. For the most part, however, the disadvantage of distance from consumers is easily borne by the localized industries because their products are either small and of light weight, or have such a high value that they can bear long shipment. In every case the labor charge is a large item in the costs of production, so that if a manufacturer must choose between cheap transportation and cheaper labor cost, he unhesitatingly votes for the labor. To locate near the market but away from the recognized center of production adds greatly to the wage list, for men can be induced to leave home only by the lure of more money in their pay envelope, and, furthermore, transplanted factory operatives lose in group efficiency, as we have pointed out. As a result, the distance separating pro-

ducer and consumer, although a disadvantage, is not the greatest of evils when goods are relatively easy to transport.

In like manner many localized industries are remote from their source of raw material, and therefore must face a freight charge upon every unit of stock they use. Here again the actual amounts to be paid are more startling than the relative, for the cost of cotton from the south, leather from all around the world, steel from Sweden, and rags from Europe, all form so small a portion of the value of the finished article that the mere freight charges on these commodities is a burden on the business that is scarcely recognizable statistically. So long as labor represents the largest single item in the total cost of production, localized industries as a whole will not be likely to seek a position nearer raw materials in order to save freight charges.

From the employers' point of view, the strength of labor unions in a localized industry is a thing that is abhorrent. Labor organizations are strongest in industries whose labor force is most highly skilled and collected in the narrowest area. In the grip of such unions, employers are helpless, and when pinched they wriggle, squirm and cry out just like any other weak thing in the grasp of power; their only relief is to run away. The unions of Lynn became so dictatorial in the matters of "closed shops," wages and hours of work, that several shoe firms, employing many hands, moved outright to Lowell, Massachusetts; or Manchester, New Hampshire. In these places, they have gained a temporary relief, but both towns are becoming shoe centers, so that in the course of time these manufacturers must submit to labor or seek a newer asylum. The power of unions in localized industries, therefore, is a strong force working toward decentralization, at least until unions cover the whole industry over the entire nation. Then there would be no escape anywhere and one place would be under the same conditions as another.

Competition is most severe where the competitors are closest together. In a localized industry, therefore, every manufacturer must accept the terms offered by any one of their number, otherwise all buyers would flock to the firm offering the lowest prices. Frequently in a localized industry the whole trade is demoralized by the presence of some beginner who, although skilled in his work, nevertheless is a poor business man, because he can not calculate costs accurately, and consequently bids for business by selling his goods below the actual cost of production. Of course he meets ruin eventually or changes his policy, but so long as he maintains his low price level, all other manu-

facturers must sacrifice profits in order to conform to it. Competition is also made a strenuous struggle by the constant strain for improved processes. No matter how carefully guarded the secret of a new device may be or how securely it may be thought to be protected by patents, nevertheless in a localized industry such a secret device soon becomes known, and every manufacturer installs it in some more or less modified form. One manufacturer's advance is immediately imitated by all others, with the result that no man can long enjoy exclusively the fruits of his own inventiveness. The study of processes is a daily grind and the race for improvements is swift indeed, yet the prize is barely attained when its value is snatched away by a new race for a new prize. This situation is highly desirable from a social viewpoint, for it tends to lower prices and widen consumption, but to the manufacturers who must bear the brunt of the business struggle, it is extremely discouraging.

From the employers' viewpoint, consequently, a localized industry has these distinct disadvantages: it is remote from its market, it strengthens the arm of labor and it promotes bitter competition. To the whole population of the town, a localized industry brings another source of dread. If, in addition to the localization⁷ of the industry, the community has specialized in it also, then the fear of hard times is alway hovering over the people. To take an illustration—as long as the United States is prosperous there is hardly a better place in which to live than Attleborough, Massachusetts, for every one has plenty of money and does not stint the spending, but Attleborough, manufacturing a luxury (jewelry), early feels a fall in the industrial barometer, and during a period of financial storm there are few places more hard hit or in which people look more anxiously for a return of better conditions. This is true of every town whose industries are not diversified.

From the point of view of employees, localization is bad because it also tends toward narrowing the minds of the townspeople. A young man brought up in Fall River, say, has but little choice of occupation; he must become a weaver or a loom-fixer or some other artisan connected with cotton manufacture, because by upbringing, education and example he is forced into that path, and furthermore he goes to work at an early age. It may happen that many a square peg is rammed into a round

⁷ Philadelphia is the center where carpet manufacture is localized, but Philadelphia has not specialized in that branch of business. Her industries are widely diversified. On the other hand, Trenton is not only the seat of the pottery industry, but the town ~~has~~ specialized in that trade. Little else is manufactured there except pottery. It is that kind of town we have in mind here.

hole in this way, or a life constricted which might under better conditions have expanded. There is something deadening to the human mind in uniformity; progress comes through variation, therefore in a town of one industry a young man loses the stimulus for self-advancement. In such a town there is little difference in social position, with the result that young people do not have the force of example prodding them to aspire toward heights above their present station. Discontent translated into action is a blessing in disguise, but in a community where all are equal, contentment with one's lot begets lethargy, because there is no contrast urging toward betterment. This contentment tends toward the creation of a laboring class that is self-perpetuating, a condition inimical to American ideals.

Indifference toward education is one of the results that flows from the creation of a labor class, for a desire for knowledge is one of the characteristics attached to progress, inasmuch as aspiration feeds on inspiration. Lowell, containing more than 100,000 people, and Lawrence, with nearly that number, each have but one high school. On the other hand, Springfield, whose population numbers about the same as Lawrence, but whose industries are highly diversified, has no less than three high schools. Worcester also has many unlike industries, and four high schools are in proportion to population three times as numerous as Lowell's, for she has one to 36,000 people, while Lowell has one to 106,000. It is a disadvantage, therefore, for a young man to grow up in a community whose industries are all alike. The chances of his getting a sound education are slim indeed.

The disadvantages of a localized industry, namely, the distance from markets for raw materials and finished goods, the strength of labor unions, the multiplication of plants, the suffering in hard times and the creation of a labor class, are outweighed by the advantages. The ability to secure the right labor, the ease of selling and advantages in buying recommend to an employer the place already established in an industry. On the part of the employees, security of jobs and opportunity for organization among the workers are strong lures toward a center recognized for a particular class of work. Therefore an industry started by a local resource or by accident continues to grow in one spot through the branching of new plants from old ones, through new concerns organized by sons or superintendents, through the advancement that comes by subdivision of product and through the accumulation of small factories that make use of waste products. Localization is therefore a persistent feature of industry.

THE NORTH SLESVIG OR DANO-GERMAN QUESTION

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IN northern Germany, just south of Denmark, is the little province of Schleswig (Danish Slesvig or Sleswic); it has been under Prussian control since 1866. In the northern part of the province are about 150,000 Danes; they have all along hoped to have this land, or at least the northern part of it, returned to Denmark, for in 1866 when Prussia acquired this province there was a clause in the treaty promising that the inhabitants of North Slesvig should be given the opportunity to vote freely whether they should belong to Denmark or to Prussia. But this clause of the treaty of Prague has never been carried out. In recent press dispatches (October, 1918) it was stated that the King of Denmark had sent a diplomatic note to Germany suggesting that she execute the terms of the treaty signed by Prussia and Austria in 1866. Later dispatches from Germany deny the receipt of such a communication from Denmark. These conflicting reports aside, it is not unlikely that when the fate of the Alsace-Lorrainers, Poles, Czecho-Slovaks and South Slavs will be determined on the principle of justice to small nationalities during the coming peace negotiations, the people of North Slesvig will also have their nationalistic claims satisfied. It is the purpose of this article to bring together the facts necessary to understand this North Slesvig question in all its historic and present aspects.

THE HISTORIC BEARINGS

The history of North Slesvig is a part of the history of two duchies, Slesvig and Holstein, which in 1864 fell under the control of Prussia and Austria and by 1866 came fully under the control of Prussia. These duchies had been owned by the King of Denmark since the fifteenth century. They had often caused international complications, but we shall need to speak only of nineteenth-century conditions. Although the duchies were owned by the King of Denmark, they were not a part of Denmark. Holstein was a part of the German confederation, but

Slesvig was not. Holstein and South Slesvig were German-speaking, but North Slesvig was Danish. According to a law of the duchies and by international treaties the two were indissoluble; whoever owned one duchy had to own the other. In the duchies the old Salic Law prevailed, which meant that the throne could be inherited only by direct male descendants of the ruling house. In Denmark this law had been given up. In 1848, Frederick VII., the last member of the male line in Denmark, became king and of course also ruled the duchies. After his death the duchies would go to the male line while Denmark would go to the female line. There was a strong party in Denmark that wished to have the duchies remain in possession of the Danish King, and if possible have them become a part of Denmark, at least that part north of the Eider River—the most of Slesvig. This aroused the fears of the German people, who wished to keep Holstein under German control, and if possible to have Slesvig become German too. The matter threatened to disrupt the peace of Europe, so in 1852 seven powers (England, France, Prussia, Austria, Russia, Norway and Sweden) signed the Treaty of London providing that the succession in the duchies remain in the Danish or female line, but that they were never to be united with Denmark. The Duke of Augustenburg, the claimant of the male line to the throne of the duchies, was paid an annual sum and induced to give up his claims.

In September, 1863, Frederick VII. granted a constitution to Denmark and Slesvig, thus implying that Slesvig was to be a part of Denmark. Frederick died in November, 1863, and his successor, Christian IX., promulgated the same constitution for Denmark and Slesvig. This was in violation of the Treaty of London. The German nation was aroused, fearing that German-speaking territory was to be forced to live under a Danish constitution. The German Diet declared in favor of breaking the Treaty of London and allowing the Augustenburg line to have the duchies. But Bismarck opposed this, for it would merely add another small state to northern Germany, a thing he wished to avoid. He demanded that the Treaty of London be observed by the King of Denmark, that is, that the constitution of Denmark be not applied to Slesvig. He persuaded Austria to support him in this demand.

As is well known, Bismarck wished to get these provinces for Prussia. Consequently he hoped the Danish King would refuse these demands and give Prussia a chance to enter a war of conquest. Therefore he falsely informed the Danish King

that the English government had threatened to intervene if Prussia and Austria resorted to war. The ruse worked: the King, expecting English aid, refused to meet the demands of Prussia and Austria. These two countries then declared war on Denmark, which after a short and decisive campaign ceded Slesvig and Holstein to Prussia and Austria to dispose of as they wished.

Just as Bismarck had planned, Prussia and Austria disagreed on what should be done with the duchies. This was the immediate cause of the Prusso-Austrian War of 1866; at the end of that short but momentous war Austria was forced to cede to Prussia the duchies of Slesvig and Holstein, and Prussia has ruled them ever since.

The Danes have always claimed, and on good grounds, that there had been various arrangements and occurrences that had strengthened the claims of the female branch, and that the Treaty of London was a crime against Denmark.¹ Whatever the merits of this claim, it is certainly far more valid than the claim of Prussia, which is based merely on the right of conquest. Since 1866 the Danes have changed their attitude. They no longer claim the whole of the duchies: they readily grant that on nationalistic grounds they have no claim to Holstein and southern Slesvig, which are entirely German, but they claim the northern half of Slesvig, which is entirely Danish. Slesvig has a population of about 400,000; those in the northern part, about 150,000, are entirely Danish.

ARTICLE FIVE OF THE TREATY OF PRAGUE

When Prussia and Austria signed the Treaty of Prague at the close of the Prusso-Austrian War, Bismarck inserted a clause reading as follows: "His Majesty the Emperor of Austria transfers to his Majesty of Prussia all his claims to the duchies of Holstein and Schleswig, with the stipulation that the population of the northern districts of Schleswig are to be ceded to Denmark, if they by a free vote manifest a desire to be united with Denmark." This article was inserted at the instigation of Napoleon III. to give him some comfort for his failure to play an active part during the Prusso-Austrian War. Bismarck undoubtedly had no intention of living up to this provision of the Treaty of Prague. In 1867 the Danish government requested that Prussia arrange for the plebiscite, but

¹ A. D. Jørgensen, "The Danish View of the Slesvig-Holstein Question," *Nineteenth Century*, XLII., 918-927, December, 1897.

received an evasive reply. At the solicitation of Denmark Napoleon III. now asked Bismarck to execute the treaty, but he retorted that this was a matter to be settled solely by the signatories of the treaty. Napoleon III. was unprepared for war, and, moreover, he was also negotiating for an indemnity in the Rhine country to offset the growth of Prussia's power which resulted from the formation of the North German Confederation in 1867, and therefore he would risk nothing more in behalf of the people of North Slesvig.² After Prussia had defeated France in 1870-1871 there was no one to intercede for the Danes, and when Prussia and Austria drew up a treaty of alliance in October, 1878 (which was the basis of the subsequent Triple Alliance), Austria consented to cancel that clause concerning the plebiscite in North Slesvig. And now after fifty-two years it is reported that Denmark is demanding that Prussia live up to the terms of the Treaty of Prague and let the people of North Slesvig determine their own political destiny. If these Danes are ever given an opportunity to hold the plebiscite there can be no doubt as to the way they will vote, for the treatment they have received at the hands of Prussia has done nothing but stir up opposition to the existing conditions.

THE LANGUAGE QUESTION

At the heart of the difficulty is the language question. The Prussian government has done all in its power to change the language of the people. It has required that all teaching in the schools must be in German. When the small children enter school they are allowed to speak Danish, for they know no German; but later they are required to speak German exclusively; if they use Danish on the playground they are punished. The Prussian government tried to Germanize the church services. In the state churches the services are all conducted in German. This has caused many on the border to go over to Denmark for religious worship; those unable to afford to do that have banded together privately and employed Danish ministers. This is not unlawful, but in one way and another, these meetings are seriously disturbed. A Prussian official must be present at every meeting. Sometimes the meetings are broken up on the ground that they have been held without securing the proper authorization. The pastor is arrested and through long delays in the trial is kept from serving his flock. The names of all attend-

² E. Bourgeois, "Manuel de politique étrangère," III., 699; A. Debidour, "Histoire diplomatique de l'Europe," II., 349.

ing such private meetings are known to the authorities and this information can be used in various ways against the offenders at suitable times. When Danes leave Slesvig to worship in Denmark or attend festivals or theaters their names are listed by officers on the border and on returning they are summoned before the district superintendent to give an account of themselves during their absence.

In the courts only the German language may be used. Danes unable to speak German must use an interpreter. If they use their own language in court they are fined. Germans and Danes do not associate with each other; each group has its own meetings and social gatherings. The Prussian government has permitted newspapers to be printed in Danish and six have been published regularly. But in one way and another these newspapers have been hampered. Freedom of the press has certainly been wanting. For saying things injudicious the editors have been fined and imprisoned; often the typesetters and other employees of the printing offices have been arrested or banished, thus delaying the printing of the paper.

There are also some German papers in Slesvig; they may print what they wish. Some are subsidized by the Prussian government and are urged to stir up feeling against the Danes. They attack the Danish delegates in the Prussian Landtag and the German Reichstag. They exalt German *Kultur* and belittle Danish achievements. The Prussian government even subsidizes one Danish paper whose purpose it is to stimulate loyalty to Prussia. Many bitter pamphlets and books against the Danes have been distributed in the province. However, it is a risky thing to say anything against the Germans. The Danish representative in the Reichstag, Jessen, was at different times imprisoned for a total of almost four years because he had made various harmless speeches that offended the Prussian authorities. For example, once he was imprisoned for four months because he said that one can easily understand why Bismarck would favor grain duties because he himself was owner of a large estate and would profit by the rise in tariff.

Three Danish societies, the Danish Language Society, the School Society and the Lecture Society, have been active in keeping up the Danish language and national feeling. They have distributed books and given encouragement to Danish cultural interests wherever possible to offset the Germanizing influence.

FURTHER BASES FOR ILL-FEELING

The main cause of ill-feeling is Prussia's effort to make Slesvig German-speaking. However, the government makes all possible efforts to check anything that is Danish. The Danish flag may not be displayed on a house or in the windows, but is allowed within the house. In all Danish homes one will find the Danish flag and pictures of Scandinavian statesmen, scientists and literary men. Since 1865 Danish songs may not be sung anywhere. Even certain Swedish and Norwegian songs are prohibited. At times the police have broken up meetings at which a certain song of Björnson, the Norwegian poet, was sung. Danish actors and lecturers are forbidden to enter North Slesvig. Once a lecture on the sun and planets was announced by a Slesvig Dane; the local officer prohibited this because he feared that the stereopticon views by which it was to be illustrated might present pictures of Danish persons and landscapes. A Danish society that has tried to improve the breed of cattle in Slesvig has been declared by the Prussian government to be political, and at all of its meetings a Prussian officer must be present, and its members must report to the officer when they arrive and leave.

The Danish colors are red and white. Hence no one may paint his fence-posts, barns or house with these colors. On one occasion the entire edition of a book with a red and white emblem was confiscated. The wearing of clothing which has the combination of red and white is regarded as treasonable by the Prussian. If people decorate the graves of their loved ones with red and white flowers they are punished. Once a farmer housed his black dog in a red kennel; the dog died and was succeeded by a white dog. Since the white dog and the red kennel produced the Danish colors the authorities demanded that the farmer paint his kennel some other color.

When special services are held in the Prussian schools to commemorate the victory at Sedan, the Danish parents are fined if they do not send their children. Many Danish young men have emigrated to Denmark and America; when they return to visit their parents they are stopped and sent out of the country. For some decades the Prussian government tried to force the Danish farmers to emigrate and have their farms taken up by loyal Prussians. Many wealthy Germans have bought lands and established villas. But in recent years the Danish population have resisted this movement vigorously. They have refused to sell their lands, the young men stay, serve

their time in the German army and return to Slesvig to keep it Danish.

In 1864, when Denmark ceded Slesvig-Holstein to Prussia and Austria, the two latter countries agreed that all Danish inhabitants of North Slesvig that wished to remain Danish citizens need not become naturalized and were to be unmolested so long as they did nothing to create sedition. No one born under Danish rule was to be banished. But after Prussia gained sole control and began her policy of Germanization she often banished Danes; in some years as many as five or six hundred were banished. Any Dane that does anything unfriendly to the Prussian government is banished. This often means the loss of good positions, business and property interests. Even the Danes that have accepted Prussian rule are subjected to annoyances. If they import Danish servants or harvest hands the government expels these workers; this may occur at harvest time when crops are lost if there is not adequate help. With all of these irritating acts of the government one would not be surprised to find that North Slesvig is a lawless country. The opposite is true. According to Prussian official statistics there is no part of the German Empire that has so few criminal cases as this region. There are only half as many cases of theft, robbery and murder as in the rest of Prussia on the average.³

North Slesvig is represented by one deputy in the Imperial Reichstag and by two deputies in the lower house of the Prussian Landtag or parliament. If gerrymandering had not taken place in 1867 there would have been more Danes in the Reichstag; there are three Germans and one Dane from Slesvig. The districts have not been changed anywhere in Germany since 1867. In these two legislative bodies the Danish representatives persistently protest against the injustice done the Danes and demand that the Treaty of Prague be observed. But their speeches are interrupted; the Danish deputies have no influence on German and Prussian legislation. However, their activities are a testimony to the fact that even a half of a century of oppression can not kill a national spirit.

³L. Warming, "The North Slesvig Question," *American Journal of Sociology*, VIII., 289-355; W. Hartmann, "Germany and the Danes in North Schleswig," *Nineteenth Century and After*, LIV., 55-65; E. Givskov, "Germany and her Subjected Races," *Contemporary Review*, LXXXVII., 813-824.

ATTITUDE OF THE GOVERNMENT AND PEOPLE OF DENMARK

The Danish people have felt very keenly the spoliation of their country in 1864 and the mistreatment of their brothers across the border. The Danish government has not been able to do anything to alleviate the situation. It quickly saw that it could not use force to regain this lost territory; the only outcome would probably be further humiliation. However, the government has quietly worked to arouse the interest of the nations in the moral issues of the question, hoping that there would come a time when the attention of the world would be directed toward the solution of this problem on the basis of justice. So now, when Germany faces a reckoning on all sides, it is not surprising that the King of Denmark, according to press reports, has requested Germany to correct the injuries of half a century by living up to her treaty obligations of 1866.

Although the Danish government could do nothing to help the unfortunate Danes, private citizens of Denmark have done much to keep alive the national spirit of their brothers across the border. Many open-air meetings have been held in southern Denmark and the people from Slesvig have gone over in large numbers to hear addresses by Danes and other Scandinavians. Organized societies have sent libraries of the best Scandinavian literature into Slesvig. Many scholarships in Danish technical schools and in the University of Copenhagen have been awarded to talented young men and women of North Slesvig. Cooperative societies have been formed by the Danes to secure help for those farmers whose Danish laborers have been banished at critical times during harvest season. Through these Danish agencies the seriousness of this Prussian interference has been greatly lessened.

THE POLITICAL BLUNDER OF PRUSSIA

Prussian treatment of North Slesvig has yielded fruits no different from those in Alsace-Lorraine and Posen. The policy of Germanization has merely intensified the Danish national feeling. In 1895 there were 143,000 people in North Slesvig; of these only 8,000 were Germans, and many of these were Prussian officials. The second generation of German immigrants usually speak Danish, and even among the first generation one third learn to speak Danish.⁴ Prussia has not only

⁴ Warming, *op. cit.*, VIII., 311. In 1905 there were 148,000 inhabitants of North Slesvig and only 9,000 spoke German. "Encyclopedia Britannica," XXIV., 340.

failed in her policy of Germanization in Slesvig; she has also estranged all three of the Scandinavian countries, not merely Denmark, but Sweden and Norway. If Pan-Germany would ever have been practicable, if the Scandinavian countries ever could have been included of their free will, the mistreatment of the Danes in Slesvig would have kept out Norway and Sweden as well as Denmark.

THE ATTITUDE OF THE GERMAN LIBERALS

German liberals, both in Prussia and elsewhere in the empire, have often criticized Prussia for her mistreatment of the Danes. But these liberals do not wish the application of the plebiscite as promised in 1866. They do not wish to have Prussia lose territory, they merely urge that the repressive measures be stopped and the Danes given greater freedom. But that solution will never satisfy the Danes in Slesvig or in Denmark. The North Slesvig question has never been prominent during the Great War, but the recently reported action of the Danish King has brought the matter to the attention of allied statesmen, and if there is to be an application of the spirit of justice and fairness to small nations everywhere there must also be a reconsideration of the wrong done Denmark in 1864, and the people of North Slesvig must be given the right to vote on their political destiny. There can be no question as to the outcome; North Slesvig will vote to return to Denmark.

THE DEMOCRATIC BACKGROUND OF CHINESE CULTURE

By BENOY KUMAR SARKAR

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IN spite of the generally acknowledged importance of historic tradition as a pre-disposing force in the political developments of a people, it may be safely asserted that the democratic ideals and republican institutions of Asia in ancient and medieval times, such as they were, can, for all practical purposes, exert no influence on her present-day experiments in nationalism and democracy. The political achievements of the Old Orient are, in fact, of no greater efficacy to the New Asia than the Periclean city-state of twenty thousand free men served by two hundred thousand slaves, the Roman *jus gentium*, the "law of nature" of the Stoics, the Patristic doctrine of spiritual equality, the Frankish *Champs de Mars*, the Visigothic *officium palatinum*, the *Vehmgerichte* of the Teutons, or the Council of Toledo can possibly be in helping modern Eur-America solve the problems of universal suffrage, the ethics of representation, referendum and recall, public ownership, and sovietic governments. But now that world-reconstruction is being consciously attempted on all hands, and old values are being revalued in every line of human endeavor, it is of the deepest import to practical statesmen and students of culture-history to recognize that the political psychology of the Orientals has been pragmatically uniform with that of the Occidentals both in its strength and limitations. In approaching the East, therefore, in the future the West should not attitudinize itself as to an antithesis, as it was the custom during the last few decades, but as to a "double" or replica and analogue.

The points of affinity between Asia and Eur-America do indeed lie on the surface. Let us confine ourselves to China for the present. On this sub-continent, a veritable museum of humanity, no traveller could have failed to notice, here and there and everywhere, the little nuclei of sturdy self-rule, the so-called village communities. The local authorities of these rural communes entirely administer the affairs of the village or township, metropolitan or provincial officers being conspicuous by their absence. The village council is composed of all the heads

of families. Sometimes its constitution is based on the choice of elders by lot. These folk-moots often exercise the greatest influence in "national" politics. Thus when in 1857 the Imperial Government of China opened the port of Canton to the British it had to encounter the utmost tooth-and-nail opposition of the city council to the measure.

The Chinese have been used to this system of local self-government since the earliest times. The elementary details of such municipal or rural institutions are given in the "Chouli," the text-book of politics compiled from still older sources in the twelfth century B.C. All through the ages the elders of Chinese communes have been elected by local meetings and have held office during good behavior. Even to-day the salaries of these officials are fixed by their peers of the neighborhood, and they are removable whenever the principal persons of the community are displeased with their conduct.

The alderman of the townships has, generally speaking, twofold functions to discharge. First, he is the connecting link between the local people and the higher authorities in matters of administration. He supervises the police, is responsible for the common weal, and enforces the necessary regulations in regard to streets, tanks, markets, festivals, collection of taxes, etc. Secondly, he is a judicial officer, the lowest in the rung of the system for the whole country. The Manchu code provided that all persons having complaints must address themselves in the first instance to the lowest tribunals of justice in the district. The petty questions arising between the men of the locality are thus attended to by the headman, and he is authorized to mete out the proper punishments.

Not less remarkable as testifying to the age-long capacity of the Chinese for collective life in order to promote joint interests are the religious fraternities, secret revolutionary societies, industrial gilds, and trade corporations. The constitution of some of the modern gilds of China is democratic with vengeance. Thus, for instance, the tea-gild at Shanghai has at its head an annually elected committee of twelve. Each committeeman acts in rotation for one month as chairman or manager. No gild member may refuse to serve on this committee. Another gild, that of the millers at Wenchow, is composed of sixteen mill proprietors. A committee of four is selected by them in such a way as to bring each member in his turn on the committee. But the ruling price of the flour each month is settled by the entire craft in conference.

The gilds make their own rules and modify them whenever

necessary. And since they are all voluntary associations owing their origin to no charter or governmental license, one can guess from the gild-rules to what a powerful extent the merchants of China are willing to be bound by the laws of their own making. One of the rules of the tea-gild at Shanghai is thus worded: "Pending litigation with a foreign firm, members of the gild shall transact no business with the delinquent firm; relations are not to be resumed till the case is adjudicated." These ultra-democratic corporations do not in reality stop short of enforcing on their members the greatest possible solidarity of interest. "It is agreed," as we read among the rules, "that members having disputes about money matters shall submit their case to arbitration at a gild meeting, where every effort will be made to arrive at a satisfactory settlement of the dispute. If it prove impossible to arrive at an understanding, appeal may be made to the authorities; but if the complainant resorts to the courts in the first instance he shall be publicly reprimanded, and in any future case he may bring before the gild he will not be entitled to the redress."¹

The autonomies and immunities enjoyed in this way by the trade-gilds and rural communes of China in matters of legislation and adjudication would be easily recognized as some of the privileges and liberties of the craft gilds and gemots of medieval Europe. One must not suspect, however, that the political genius of the Chinese displayed itself solely in the administration of such parochial entities, the atomistic units of government. The *forte* of the people lay in centralization and unified control as well. In the study of Chinese polity we are familiar not only with the phenomena of feudalistic disintegration, provincial autonomy, *laissez faire*, and home rule, but also with pan-Chinese nationality, *federation de l'empire*, and real *Weltherrschaft*.

Solid political homogeneity was achieved on the Chinese continent on several occasions. The "Son of Heaven" did then become *de facto*, as he always was *de jure*, the *hwangti* or Bar-tolus's *dominus omnium*, of the whole empire. The supreme government of the Manchus, for example, consisted of two Imperial Councils of deliberative character and six administrative boards. One of the councils, called the general council, organized first about 1730 was composed of any grandees, as princes of the blood, chancellors, presidents and vice-presidents of the six boards, and chief officers of all the other metropolitan courts.

¹ *Journal of the North China Branch of the Royal Asiatic Society*, 1886, New Series, Vol. XXI., pp. 133-192.

The various branches of government were consolidated and their harmonious action facilitated by this agency. It served further to make up for the shortcomings of a degenerate ruler and act as a check on the arbitrary measures of a tyrant. The government and direction of the entire civil service of the Manchu empire were left to the care of one of the boards, called the Board of Civil Office. Similarly the other boards were entrusted with duties concerning all the people of the empire. All this contributed no doubt to administrative unification.

The eighteen provincial governments had, as Williams calculates in the "Middle Kingdom," about 2,000 officers above the rank of the assistant district magistrate. Personal touch with the supreme government was ensured by the rule that every high grade officer had to report himself in writing twice every month. Appeals from the lowest courts of the village elders to the higher tribunals of the provinces and the empire served also as strong centripetal influences. Besides, the system of literary examinations by which all officers were appointed to important posts was thoroughly imperialized. The hierarchy of teachers and examiners from Peking to the villages was complete. The "literary chancellors" of the provinces were, like the civil and military governors, appointed by the emperor himself. Altogether, we have here the picture of a France centralized under the Intendants of Richelieu for an area five or six times as large.

It must not be surmised, however, that the king's power in China was a pure despotism. The Chinese polity was never without a conciliar element, the acts of the king being always subject to the control of the chief ministers. No individual could be appointed to a high post by the emperor alone. The ministers had the right to recommend or present a fit person. The king might indeed reject him, but even this prerogative appears to have been controllable, as may be gathered from Werner's "Chinese Sociology" (p. 52), by the united voice of ministers.

The restraints on the power of the king and the value of the council of ministers in the constitution of the state are strongly borne out by Chinese tradition which can be traced back to hoary antiquity. Thus from the earliest times it has been taught, both by examples and precept, says Meadows in "The Chinese and their Rebellions," that no man whatever had a hereditary divine right to the throne, nor even any son of its last occupant. The "five legendary rulers" (B.C. 2852-2255), whom Confucius has immortalized for his countrymen in the

"Shooing" (Book of History), treated the kingdom as belonging to the nation. The doctrine of the state as public property was forcefully demonstrated, as is known to every Chinese of all ages, when Yao (B.C. 2356-2255), one of the "model kings," selected the worthiest from among the people as his successor.

The political psychology of China is likewise nurtured on the democratic imagination fired by the exemplary conduct of Shoon (B.C. 2255-2205), another of her model kings. He had a tablet placed outside his official residence whereon any one could criticize his administration. Public opinion was thus brought to bear upon his own work. He used also to put questions to the people in the Ming Tang, a sort of national assembly, with special reference to the names of bad characters or undesirable citizens. Participation of the people in the function of government entailed necessarily a check on the royalty itself.

Further, as Simcox makes it clear in "Primitive Civilizations,"² it is treated almost as a constitutional principle that when the king of China misbehaves it is the duty of the most virtuous and powerful of the provincial princes to depose and succeed him. There is, for instance, on record the actual confinement of the sovereign Tai Chia by the minister I Yin in a palace at Tung near the ruins of the former king "until he gave proof of reformation." With reference to this incident Mencius (B.C. 373-289), the great Confucian sage, was asked whether worthies being ministers might banish their vicious sovereigns in this way. The reply was given to the effect that if they had the same purpose as I Yin, they might, otherwise it would be usurpation.³

To an American whose mentality is normally as far removed from Dante's "De Monarchia" as the modern spectroscope is from Aristotle's optics or the Harveyan circulation of blood from the Galenian physiology, all this is but a poor preparation of Asia for the responsibilities of the modern democracy. True, but the fact remains that monarchy, absolute even when "enlightened" and benevolent, has been the most tenacious and persistent form of government in the occidental world also. Indeed, if Napoleon III. had not been defeated by the Prussians at Sedan, it is an open question if there would have been a republic in France to-day.

Institutionally speaking, then, the political experience of

² Vol. II., p. 18.

³ "Mencius," Book VII., Part I., XXXI.

Asia has not been essentially distinct from that of Europe. What about political theorizing?⁴ Here again we find the same parallelism and identity between the East and the West. For instance, to take only China, no political thinker could be more radical than the "superior men" of the Confucian classics. It is often said that Chinese culture is but Confucius "writ large." We need not accept the statement as implying that one abstract word "Confucianism" sums up and explains the whole mentality of entire China. But it may still be maintained that like the "Iliad" and the "Odyssey" of the Hellenes, the "Shooing" and the "Sheking" (Book of Odes) have furnished the *mores* of the Chinese people for over two thousand years. The "Divine Comedy" has not been the bible of Catholic Europe to a far greater extent than the Confucian texts and their commentaries to the upper ten thousands as well as the dumb millions in China.

What, now, are the political tenets of the Chinese classics? The idea of the position of the people as supreme is the cornerstone of the *Shooing* politics. We are told:

It was the lesson of our great ancestor:
The people should be cherished;
They should not be down-trodden;
The people are the root of a country;
The root firm, the country is tranquil.⁵

Interests of the people are carefully safeguarded in another advice: "Do not oppose the people to follow your own desires."⁶

Passages like these have been handed down from generation to generation, and to-day they are on the lips not only of intellectuals like General Li, Premier Tang and Foreign Minister Wu, but also of the rickshaw coolie and the junk sailors. They know also the maxim that "of all who are to be feared, are not the people the chief?"⁷ This is the Chinese version of the saying: "The fear of the people is the wisdom of the lord."

What, again, could be more conducive to the "dignity" of the people than the oft-quoted proverb?—"The great God has conferred even on the inferior people a moral sense, compliance with which would show their nature invariably right."⁸ The "Shooing" can be cited also in a campaign of popular sover-

⁴ Vide "The Doctrine of Resistance in Hindu Thought" in the author's article on "Democratic Ideals and Republican Institutions in India" in the *American Political Science Review* for November, 1918.

⁵ Part III., Book III., Ch. II., 1.

⁶ Part II., Book II., Ch. I., 6.

⁷ Part II., Book II., Ch. II., 17.

⁸ Part IV., Book III., Ch. II.

eignty. As might be naturally expected, the newspaper men of recent times have succeeded in bringing to the forefront the conduct of the king who followed the principle of limited monarchy when he admitted: "I consulted and deliberated with all my ministers and people and they are of one accord with me."⁹ There is thus no place for arbitrary rule in the political consciousness of China.

Indeed, *vox populi vox dei* is the first postulate of Chinese political philosophy. A popular maxim was given by Chang in his commentary on Confucius's "Great Learning." It runs thus: "By gaining the people the kingdom is gained, and by losing the people the kingdom is lost" (Ch. X.). The origin of this doctrine of the will of the people is to be traced, as was done by Mencius, to the ancient "Great Declaration," which says: "Heaven sees according as my people see; Heaven hears according as my people hear."¹⁰

Mencius himself can be cited by advocates of active resistance. For he openly discussed the question, "What fault is it to restrain one's prince?" and his answer was clear: "He who restrains his prince loves his prince."¹¹

Mencius is likewise an authority in a case for the deposition of a ruler. According to his advice, if the prince have great faults the relatives ought to remonstrate with him, and if he does not listen to them after they have done so again and again they ought to depose him.¹²

Like Milton, Mencius is a defender of regicide too. The king asked: "May a minister then put his sovereign to death?" Mencius replied:

He who outrages benevolence *proper to his nature* is called a robber; he who outrages righteousness is called a ruffian. The robber and the ruffian we call a mere fellow. I have heard of the cutting off of the fellow, Chow, but I have not heard of the putting a sovereign to death in his case.¹³

The logic of Mencius here is similar to that of the most outspoken anti-imperialist of the eleventh century, Manegold of Lautenbauch, who defended the expulsion of Tarquin from Rome on the ground that kingship ceases to be legitimate when it ceases to promote justice. In fact, the Mencian creed is Rousseausque in its radicalism. "The most important element in the state," declares this protagonist of Chinese democracy, "is

⁹ Part II., Book II., Ch. II., 18.

¹⁰ Mencius, Book V., Pt. I., Ch. V., 8.

¹¹ Book I., Pt. II., Ch. IV., 10.

¹² Book V., Pt. II., Ch. IX., i.

¹³ Book I., Part II., Ch. VIII., 2, 3.

the people; next come the altars of the national gods; least in importance is the king." Further, "By observing the nature of the people's aspirations we learn the will of heaven." In Chinese ethics the divine "sanction" is thus subordinate to the sanction of the demos.

A cynic may reasonably ask: "How much of this philosophical radicalism or intellectual Bolshevism was embodied in actual institutions of the Chinese polity?" The answer would be furnished by a parallel situation in Europe. According to the theory of the lawyers, *e. g.*, Ulpian (second century A.D.), the source of political authority was the people. But from Hadrian to Justinian (117-565) the emperor's will was law. And in the fourteenth century Bartolus (1314-57), the "prince of jurists," was but maintaining the trend of traditional jurisprudence when he affirmed that the Roman Emperor was "*Deus in terris*" and "*sempiter nus*," and that to dispute him was sacrilege. Similarly the modern ideas of natural equality, freedom, justice, etc., can be carried, as has been done by Carlyle in "Mediaeval Political Theory in the West," back to Cicero (106-43 B.C.) through the Church Fathers and the Roman jurists. But, for two thousand years slavery was recognized as a lawful and legitimate institution, privileges and inequalities were the norm in socio-civic life, and the divine right of the king was an established fact. It was not until the French Revolution that a legalized constitutional measure was adopted to give effect to the doctrine of natural equality which was first promulgated by the Stoics in opposition to the theory of the Aristotelians. The discrepancy between theory and practise in the political sphere is thus not less occidental than oriental, after all.

PRINCIPLES AND PROBLEMS OF INTERNATIONAL RELATIONS

By Dr. P. G. NUTTING

THE behavior of one nation toward another is in accord with those principles of biology relating to all life and growth. During extended periods of peace, amity and equity, growth and development are more or less continuous and uniform. Interspersed with these normal periods are intervals of violent readjustment of interrelations, periods of extremely rapid development along special lines and of general reformation of objectives, practises and habits. A similar statement would apply to the life of an individual and with slight modification to each living cell composing the individual.

There is little to discuss in this simple biological principle, interest centers rather in the details of its operation; factors in development, the influence of race, religion, education, climate, natural resources and great leaders on growth, rational international law and ethics, the part played by component individuals and organizations, the rationality of selfishness and of altruism and the proper balance between strong and weak components. Finally, in the consideration of a rational world state may be found a criterion of rationality in international relations.

In the last analysis, those rules of international relations will prevail which are backed by the greatest bulk of resources; natural resources and resources in intellect, in capital, in labor and in incentives to action. Even such fallacies as the idea that mere military might makes right and that the end justifies the means would be established, but that they are backed by but a small fraction of the world's strength in resources. We are now witnessing some titanic appeals to worldwide public opinion, and there is no doubt whatever but that the final decision will be in accord with the consensus of that opinion. Let us therefore examine some of the more important and characteristic international problems on the basis of the fairly certain estimates of the judgment of the world's voting power in resources.

The right of an established nation, however small or weak, to exist and work out its own destiny in its own way has been

almost universally recognized. The right of powerful nations to expand at the expense of neighboring small nations has been claimed, but has been repudiated by the majority. The love of fair play is so nearly universal that whenever a decision is forced, the result is assured. Nearly every one detests a bully and loves to see him humbled. The gobbling up of smaller nations by larger is abhorred as a species of cannibalism.

A closely related problem is that of the right of a nation to conduct its own internal affairs as it sees fit. This right is quite universally claimed and quite as generally conceded—within limits. Properly speaking, the political right has been conceded, but the moral right has been denied, in particular when the rights of subject races, colonies or other components have been violated. The problem is comparable with that of the right of a family to settle its own affairs. Within certain limits this is conceded; without those limits police interfere and courts decide. The Spanish-American War was brought on by the treatment of Cuba by Spain and the same love of fair play at the root of the moral interference that led to the blowing up of the *Maine*, caused us to leave Cuba to work out her own destiny. Doubtless in time international politics and courts will enforce properly devised international laws defining and setting limits upon the rights of nations to handle their own internal affairs.

A similar problem concerns the right of any sovereign state to treat any other state as it pleases; to restrain trade with or to make war upon it, for example. No limitations have heretofore been recognized as binding on any nation, but international public opinion is overwhelmingly in favor of such limitations. Happily the nations are but few which will claim the right to break their own treaties or to make destructive warfare upon whom they will. A somewhat analogous case would be the assumed right of one individual to fight another. Certain kinds of fighting are tolerated within certain limits, but beyond those limits is forcibly prevented. It is to be hoped that the time is not far distant when just laws shall define and delimit the rights of nations in their dealings with each other and an efficient international police see that such laws are enforced. These laws will be such as will meet the approval of the bulk of the human race and such as that majority is prepared to back up with all its resources. They can not recognize either special privilege or divine right and must be such as will effectually inhibit attempts at world hegemony. They must define moral rights, but in no way interfere with legitimate growth and de-

velopment, nor permit the interference of one nation or race with the development of another. Moral right must be the basis for international law, not because it is moral, but because no other basis will make for the stability and progress of all nations and all races. An unfair law would be doomed for lack of general support.

That group of problems centered about colonization is varied, complex and difficult except from a certain point of view. The degree of association of one people with another varies from equality of sovereignty down to colonial relationship and at the limit the more or less complete subjection of almost unimportant subject races. Evidently these problems cover the entire field between international and internal problems. The determination of the rights of sovereignty of one people over another has thus far, in most cases, been the natural one of the ability of the one people to establish control over, or, conversely, independence from the other. If either is not done by reasonably humane methods and within a reasonable time, the internal problem becomes an international one and subject to outside interference. The moral principle is vague but simple; within the bounds of fair play all is permissible, without those bounds revolt and interference are to be expected. A colony fairly treated gives the mother country her choicest trade and choicest sons in return for protection and prestige. That Great Britain's colonies have voluntarily made great sacrifices to assist her in the world war we regard as complete proof that she had been treating them fairly. The Anglo-Saxon is a successful colonizer the world over because of his innate love of fair play and his ready recognition of the rights of others. Several nationalities are notoriously poor colonizers for lack of those very qualities; they are too selfish, too long on authority and too short on equity to win the respect and confidence that are essential.

The problem of proper relationship between mother country and dependencies is capable of a clean cut solution from the biological viewpoint. The treatment which a dependent state or race should receive should be measured in terms of its resources, natural, intellectual, manual and financial, and the activity of those resources—the sum of its total potential and kinetic energies, to use a mechanical analogy. Great Britain learned this principle when she lost the bulk of her American colonies a century and a half ago. Her present relations with Canada, South Africa and Australia are evidence of her ability, not only to correctly apply the principle, but to keep pace with

rapidly changing conditions in her dependencies. Autonomy in proportion to strength measured in general resources as stated above is the only fair policy and therefore the only policy which will work in the long run. The greedy anxiety of one state to forcibly establish or retain authority over another would be fine comedy, were it not so tragic. If a nation desires leadership and has the natural resources, it should bend its energies to the development of its utmost intellectual, manual and financial resources and to the establishment of a record for fair dealing, leadership will follow as a matter of course. Trade, intellect, labor and capital will flow in from outside of their own accord. The resort to arms or to secret propaganda by any nation in order to extend its authority is merely a confession of failure to recognize, or inability to use, legitimate and therefore effective methods. Such policies are comparable with merely "lifting by the bootstraps" in order to raise one's self. A nation, like an individual, has but to live up to its possibilities to safeguard its future.

The biological principle of relative bulk and activity in the four chief kinds of resources has been stated to be necessary and sufficient as a guide in international relations. Why this is so it would be of interest to inquire, but such a problem is not so much one in engineering as in metaphysics. The answer is not far to seek in the theory of evolution, since it makes for the ultimate good of the entire human race. The reason why the ultimate good of the whole human race is to be provided for is the outside limits of this discussion.

The solution of the problem of war from the fundamental biological viewpoint has been merely indicated above and is worth a more complete analysis. From that point of view wars are harmful according to their aggregate effect on the human race. "Good" wars stimulate or otherwise cause development which outweighs the concomitant exhaustion of resources. Wars which relieve from repression and misgovernment are such. All attempts at world hegemony have failed and nearly all wars waged to that end have caused a loss in exhaustion of resources far outweighing all gains by stimulated development. The mere establishment of authority over other nations, as Napoleon did, is but an empty honor and does no good to be compared with the evil of draining a great nation of its best manhood nor with the far-reaching good of a great scientific discovery. Good wars, on the other hand, are such as throw off restraint seriously interfering with development or establish rights and principles of far-reaching human value. Wars of

conquest and attempts at world hegemony are now so thoroughly discredited that it is not unreasonable to hope that there may never be another. Whenever national activities run strongly counter to the biological principle of the greatest good to the greatest number, however, wars are to be expected and even hoped for. To oppose such warfare would be to take a narrow and selfish view unless the same end may be attained by peaceful means. It is probable that a league of powerful nations will enforce the principles of equality of rights and of fair play, making further wars to secure such unnecessary.

A world state would more than justify itself if it secure international stability and progress. To accomplish this it must stand squarely for the abolition of special privileges among all nations, races and classes. It must have supreme authority and means of maintaining that authority in order to be stable and effective. It must leave to individual nations the entire management of their internal affairs so long as that management is in accordance with the principles of equity. It must have tribunals to decide upon questions of equity and a legislative body to formulate just international laws and keep those laws abreast of development. Legislative authority and administrative expenses may well be apportioned according to resources, but executive and judicial officers might well be selected without regard to resources or even nationality, demonstrated ability and fitness being sufficient.

Aside from political functions, such a world state might well concern itself with many international problems in general warfare. (1) It might conduct surveys of world resources; natural resources, financial resources, organized knowledge and labor, examining into means of enhancing and utilizing such resources. (2) It might well assume the care of public health, particularly as affected by transmissible diseases, plant and animal as well as human. (3) International commerce, banking, communication and labor movements might well be given considerable assistance in the nature of directive and stimulative influence by such a world state organization.

The advantages to be anticipated from the formation of a world state are quite similar to and of far greater magnitude than those accruing from the union of our own states in a strong central government. If such an international organization is formed, it is to be hoped that it may be so well organized as to receive the loyal support of all peoples and be given such authority as to command the respect of even the strongest and most perverted of nations.

ADAPTATION IN BONE ARCHITECTURE¹

By Professor R. M. STRONG

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WE recognize two types of bone: compact and cancellous. In flat bones we have the latter as the diploe between two layers of compact bone. In long bones there is a tubular structure of compact bone with a varying amount of cancellous bone inside.

For instance, in the human femur, the shaft portion is a tube with a wall of compact bone which is thick except near the ends; here the compact bone becomes thin and is continued over the swollen ends of the femur as a thin layer. In the shaft region of the femur, the cancellous portion is represented by relatively few and widely separated bone trabeculae. The space inside the tube of compact bone is occupied mostly by marrow. In the enlarged end portions of the femur, a complicated system of crowded trabeculae produces a spongy structure with small interspaces.

The enlargements at the ends of the femur furnish needed surface for the attachment of muscles, tendons and ligaments. They are also important in the joint mechanism. The spongy structure permits an enlargement without increased weight.

The central spaces, even though occupied by marrow, give the bone some of the architectural advantage of a tube over a solid rod, *i. e.*, greater rigidity or resistance to bending strain than is possessed by a solid structure of the same length and weight of material.

In many birds, and especially in some larger forms, this architectural advantage has been carried still further, and we have decidedly hollow bones with no heavy marrow. Even the bone trabeculae have disappeared more or less completely, and the hollow spaces are occupied by evaginations from the lungs, the air sacs. The extent of this pneumatization of the bones varies, but in a bird like the albatross it is extraordinary. The vertebrae with all of their intricate contour are hollow, and these air spaces extend into the smallest processes. There is no solid bone much thicker than writing paper except in the

¹ An address at the University of Illinois Summer Graduate School of Medicine, Aug. 30, 1917.

leg bones. The skull may be said to have thin layers of compact bone separated by an extensive diploe which has its bony elements often reduced to slender spicules with very large air spaces instead of marrow. The bones of the albatross are consequently exceedingly light in weight.

Bones containing air spaces are not confined to birds. In mammals, we have air sinuses in the skull which are connected with the respiratory tract and are lined with membranous extensions from the respiratory passages. Such sinuses are especially well developed in the skulls of the larger ungulates, and they are familiar structures in man. In a group of fossil reptilia, the Dinosaurs, pneumatization of the skeleton was apparently developed as far as in any of the birds, and possibly more.

In spite of their apparently frail structure, I have found albatross bones surprisingly strong and capable of withstanding relatively severe tensile and compressive strains. Their factors of safety are large. Thus the articular processes of the vertebrae resist bending strains of great severity. Though the amount of real bone tissue present is small, and the bulk of the vertebra is air space, a pull of 28 to 42 pounds applied in the most critical direction was necessary to produce fracture. This strain was, furthermore, not in any direction that tensile or bending strains would be likely to take in nature. Pressures of twenty to thirty kilograms applied to the vault of dry skulls from young albatrosses of a small species produced a crack in the sphenoidal region, but no rupture of the vault. These figures underestimate the strength of most parts of the albatross skull in spite of its great lightness and pneumaticity.

Tests of fresh normal human compact bone by Hülsen² and by Rauber³ indicate its very great strength and are illuminating here. Thus a tensile strength of 9½ kilograms per square millimeter, or 13,000 to 17,000 pounds per square inch, was found. The compressive strength is still greater, the figures varying from 12½ to about 19 kilograms per square millimeter or 18,000 to nearly 20,000 pounds per square inch. The following factors of safety for various parts of the human femur in running are given by J. C. Koch in an excellent paper on bone architecture.¹ For tensile strength, the variation is between 5.68 at the weakest point in the neck to 53.6 in the head. For compressive strength, the figures vary between 5.1 in the neck

² *Jahresber. d. Anat. u. Entwickl.*, 1898, Bd. I, p. 146.

³ *Elasticität und Festigkeit der Knochen*, Leipzig, 1876.

¹ *Am. Jr. Anatomy*, March, 1917.

to 119.5 near the proximal end of the femur. These figures are doubled for walking, but are very much less in the case of impact due to jumping or falling. However, there are of course compensatory movements of muscle contraction and flexing of joints which offset the effect of impact more or less.

The strains due to muscle contraction are ordinarily much less than those due to loads or to impact. Thus Koch states that the greatest possible contraction of the thigh muscles would "develop only about one seventh of the strength of the femur." He also says that the tensile strength of bone is about 230 times that of muscle. In various tests that I have made, using a steady pull, I have found that muscles and tendons will break before any significant strain is placed on even such slight structures as the cervical ribs of an albatross vertebra. I have not found any way of measuring the strains which muscles and tendons actually exert in normal activity, but they must be far within the factor of safety.

Nevertheless, there are some curious contradictory facts in clinical records. Thus Stimson in his book on "Fractures and Dislocations" mentions various fractures which were the result of muscular action. An athletic man broke the humerus of his throwing arm just below the insertion of the deltoid, in throwing a stone. The femur has been broken in attempts to kick, to avoid a fall, in drawing on a boot, or in turning over in bed. A primipara broke her sternum in labor, trying to assist the action, rising on her heels and elbows. Fractures of the patella from muscular action are not uncommon, and they also occur at the tuberosities of the long bones where powerful muscles are attached.

I recall a fracture of one of the long bones of the wing of a gull struggling to free itself from my grasp. My hold happened to slip to one wing for a moment. Ordinary tests of the wing-bone resistance to bending strain do not suggest such a possibility.

Apparently, sudden and violent contractions of groups of muscles may produce strains greatly in excess of our measurements. Surprising feats of strength are performed under the influence of strong emotion or mania. The large factors of safety indicate provision for unusual as well as normal strains, but it is also obvious, as Stimson says, that "Nature's precautions are as a rule calculated upon the basis of the probable, not of the exceptional." These fractures evidently involve abnormal strains.

My tests have been made with dead tissue. I have used both

fresh and fixed material, and I know of no data concerning the relative strength of living and dead tendons or muscles. These cases of fracture of bones from muscle contraction and the unusual feats of strength just mentioned suggest that muscle tissue may possibly have in life a greater strength than immediately after death. The tests I have made were simple and involved tying a string about the muscle or tendon, with the other end fastened to a spring balance which was subjected to a steady pull. The following tests were made with albatross tendons from formaline fixed specimens. Tendons of the longus colli muscle inserting on cervical ribs at about the middle of the neck broke under a pull of four to five kilograms. A biventer cervicis tendon ruptured under a strain of about two and one half kilograms. A small species of albatross, *D. nigripes*, was used. Fresh longus colli tendons attached to cervical ribs at about the middle of the neck of a gull, ruptured under a pull of one and one half to two and one half kilograms. Such results indicate large factors of safety for these structures. Most of the albatross cervical vertebrae, for instance, receive a pair of longus colli tendons. Neither the weight nor the habits of the albatross would seem to require, even in emergencies, such large factors of safety; yet they are probably not larger than is necessary for occasional but not very rare strains.

Much has been written about the remarkable adaptations in the human femur to its functions as well as those of other bones. We may mention especially the publications of Roux,⁴ Julius Wolf⁵ and J. C. Koch. The paper by Koch mentioned earlier in this paper puts the subject on a sounder and more mathematical basis than it was.

Longitudinal sections have demonstrated that the trabeculae of the proximal end of the femur, for instance, are arranged in series which cross each other at right angles. Furthermore, these trabeculae have been shown to have the direction of the lines of maximum tensile and compressive strength. They are arranged to meet the severe strains which the femur experiences, normally, and they involve a great economy in material. The efficiency of such a bone is well indicated in the following quotation from Koch: "The various parts of the femur taken together form a single mechanical structure wonderfully well adapted for the efficient, economical transmission of loads from the acetabulum to the tibia; a structure in which

⁴ Biol. Centralbl. 1881, Bd. I; also Zeitschr. f. orthopaed. Chirurgie, 1895-6, Bd. 4, p. 284.

⁵ Das Gesetz der transformation der Knochen, 1892, Berlin.

every element contributes its modicum of strength in the manner required by theoretical mechanics for maximum efficiency."

The publications of Wolff and of Roux have given us a large amount of data illustrating the possibilities of bone adaptation under exceptional conditions. In cases of fracture with imperfect coaptation and in disease, remarkable rearrangements of bone structure to meet new conditions occur. Thus Wolff has described cases of extra-capsular fracture of the femur through the neck and greater trochanter. In one case, some of the medial cortex of compact bone belonging to the upper fragment was driven into the cancellous bone of the lower fragment. In the union that followed, adaptive rearrangements of trabeculae to meet tensile and compressive strains occurred. Likewise in another case where compact bone from the lower fragment on its medial side was driven into the cancellous bone of the upper fragment, adaptive rearrangements of trabeculae followed. Local thickenings of the cortical compact bone also occur in such cases.

In fractures which involve widely separated fragments, bony bridges are formed. These involve large readjustments of both external form and internal architecture.

In a remarkable case described by Roux,⁶ a false joint developed as a consequence of imperfect union of a fractured bone. The fracture was of the tibia at the juncture of its upper and middle thirds. This was followed by an extensive hypertrophy of the fibula which became larger than the tibia and took over its functions. The tibia suffered an actual reduction in size. The fibula also increased in length so that it formed an articulation with the lateral condyle of the femur. The enlargement of the femur is said to have involved the formation of normal healthy bone.

Other fractures have been studied in such detail, and the results have been similar in demonstrating transformations to meet new conditions.

In ankylosis of joints, a remarkable unbroken continuity of the trabeculae of the two fused bones, may be established. This involves a reorganization of the cancellous bone. Changes in the thickness of the compact bone take place at points far removed from the ankylosing joint.

The well-known effects of unusual or excessive strains or loads upon developing bone involve deformities which have also been shown to undergo changes in architecture. From this

⁶ Biol. Centralbl., 1891, Bd. I, pp. 241-51. See also Julius Wolff, 1892, Das Gesetz der Transformation der Knochen, Fig. 49, Taf. VII.

knowledge has arisen the practice of orthopedic surgeons of removing a deformity producing load or strain and the use of corrective treatments involving artificially applied loads or strains.

This adaptiveness of bones to new conditions has not been generally realized by biologists, I believe. It was not known to me until very recently, and it has suggested to me some reflections concerning the origin of bone architecture. Let us review briefly the principal doctrines of evolution and discuss the bearing of bone adaptation on them.

Though natural selection has undoubtedly been an important factor in the evolution of the skeleton, it is likely that other factors have been more potent. Recent opinion holds natural selection insufficient to account for the enormous progress of evolution. Many believe that it does not originate characters, but simply favors more suitable variations while rejecting the unfit.

It is difficult to conceive of all the complex organization of the femur for its functions as a consequence of sudden changes or mutations, even though we grant the possibility of more than one mutation in the same direction.

In orthogenesis, we have an interesting viewpoint. It is easy to think of continuous variation in a definite direction as potent in evolution when we see fine series of intermediate stages. Unfortunately, there has been much vagueness about this hypothesis. Various opinions have been expressed as to what the motive principle may be. We have had various kinds of orthogenesis with intimate relationships to other evolution doctrines. The hypothesis of Nägeli is generally classed as orthogenetic. Greater perfection, more complex organization, greater division of labor, perfection of adaptation were believed to be principles of the organism. A perfecting principle carried by the germ cell was the central idea. The germ plasm has an organization which tends to produce variation in the direction of the most advantageous structure which is compatible with its degree of structure, of complexity and division of function.

The late Professor Whitman was much impressed with Nägeli's conception and he worked out a hypothesis not very different from that of Nägeli. According to Professor Whitman, the germ plasm may contain some condition of its organization which is responsible for continuous cumulative variation. In breeding experiments with pigeons, for instance, he obtained evidence that variation has been in the direction

of a barred pattern from an originally checkered pattern. Professor Whitman was sceptical concerning the possibility of environmental changes being effective. He had been for many years an embryologist and was naturally influenced by the ably supported doctrine of Weismann: the continuity of the germ plasm.

Unfortunately for orthogenesis, we have no data, and in fact hardly even a guess, as to what the germ plasm attributes may be which would be responsible for orthogenesis.

Since the announcement of Weismann's continuity of the germ plasm, there has been a curious division among biologists concerning the so-called Lamarckian doctrine of evolution as the consequence of inheritance of acquired characters. We know that much of this disagreement has been due to a failure to agree on what constitutes an acquired character. There has been some loose thinking and much quibbling. Furthermore, viewpoints have been too limited and data too meager. Accepting the embryological viewpoint that an acquired character is somatic, we have biologists with a large embryological horizon referring all evolutionary progress to the germ cells. On the other hand, paleontologists with the marvelous adaptations of the skeleton constantly before them have remained defenders of the importance of environmental factors, of use and disuse.

To a certain extent, it must be admitted, the paleontologists have been ignorant of, or oblivious to, the exceedingly strong evidence which supports the conception of continuity of the germ plasm. On the other hand, I believe that this doctrine has been too sweepingly asserted by the embryologists, and I think that the truth lies between these viewpoints.

Of course we can not deny that in sexually reproducing organisms the fertilized egg must contain all the factors for characters not actually acquired by the individual in ontogeny. The question is can a somatic change, for instance an alteration in the femur, be transmitted to the offspring. To provide for the germ cell equipment that must be involved we recall various hypotheses of pangenesis involving ultra microscopic particles, gemmules, etc. So far, at least, these attempts have not emerged from the field of pure speculation.

Sounder conclusions are to be expected from work in experimental evolution, but the dangers of false interpretation are great. There are confusing intricacies and numerous uncertain factors to trip up the investigator. Long periods of time are apparently necessary for significant results.

"The brilliant progress in heredity of recent years, beginning in 1903 with the rediscovery of Mendel's law, should not blind us to the four broad deductions from paleontology, that transformation is a matter of thousands of years, that to the living observer all living things may be exclusively stationary, that invisible tides of genetic change may be setting in one direction or another observable only over very long periods of time, that discontinuous mutations or saltations may be mere ripples on the surface of these tides."²

Until very recently, experiments testing the effects of environmental changes have mostly given doubtful evidence of transmission of new characters to the offspring. Usually, each generation has apparently had to start where the parents began. Nevertheless, the results have not all been negative. Thus Tower has obtained inherited alterations in pigmentation of potato beetles as the consequence of changed environmental conditions during the period of germ-cell development. Experiments on the effects of alcohol on the offspring when given to the parents, MacDougal's work with plants, and other experimental work recently done, all indicate susceptibility of the germ cell to external stimuli. One clear undisputed case alone of such susceptibility to external stimuli which is potent in inheritance, *i. e.*, results in new characters for the offspring, should be sufficient to overthrow the dogmatic assumption that the germ plasm can not be affected by changes in the environment so far as heredity is concerned.

The germ cells are not hermetically sealed in the gonads. There is no evidence that they are not reached freely by the blood stream with its contained internal secretions and various unknown elements. We have had much new evidence recently of the intricate and extensive relationships of tissues to each other, physiologically. The form in which influences reach the germ cell is unknown to us, but so are the agents of many other biological phenomena which we know exist. It is not improbable that the factors which are responsible for changes, in the femur, for instance, are associated with the cell organization.

Adaptation phenomena are more numerous than we often realize. Temperature control, regeneration and regulation processes are examples of adaptation. The activities of phagocytes and some of the wonderful phenomena of immunity are also illustrations. If a bone is broken, osteoblasts inactive for years and ordinarily destined to remain idle resume inactivity, and other bone-forming processes begin. We do not know what are the agencies which start these activities, but the results are obvious enough.

² H. F. Osborn, *Am. Nat.*, April, 1912, pp. 185-6.

Possession of an adaptation does not insure supremacy or survival. Another competitor may have a better adaptation. Not all advantages in the struggle for existence are possessed by a single organism. Many individuals of various species and groups are in complex competition with each other. Adaptations are furthermore subject to the limitations of heredity and environment. An automobile can not fly nor can a locomotive swim, yet both are highly adapted to their functions.

The occurrence of apparently useless or even disadvantageous characters has been used as an argument against characters being adaptive. Characters apparently highly adaptive have been explained as accidents of development or of evolution. All such arguments are beside the mark. They involve a failure to consider other forces and principles in their relationships to adaptiveness as a characteristic of protoplasm. Adaptive tendencies may be handicapped by other tendencies or forces. Heredity may preserve a character past the period of its usefulness.

We have had much new evidence in recent years of the amount of adaptiveness possessed by lower organisms. Even the ameba has been shown to be more resourceful than was at one time suspected. The more elaborate the organization, the more varied and effective are the adaptations.

The problem of explaining the origin of adaptation is made difficult because changes beyond what may be acquired in a single generation are inhibited by the *conservative forces of heredity*. In the germ cell we find permanency. There are located all those forces involved in heredity which preserve the type. Germ plasm tends to beget the same plasm. Ultra Mendelianists have even gone so far as to deny the possibility of any evolution except by recombinations or losses of germ plasm units. The mutationists account for mutations as the result of small spontaneous germinal changes. These writers, and especially the Mendelianists, are over impressed with the precision and scope of heredity. They fail to recognize the *interplay between heredity and adaptation..*

It is not easy for the organism to break away from its inheritance, especially in certain characters. Furthermore, it is conceivable that adaptations reach limits or that heredity may become too strong for a change to occur, even with great environmental changes. In fact, it is difficult to explain the failure of lower organisms to have evolved further than they have on any other basis. I believe that there is much significance in the old idea of varying degrees of plasticity with regard to sus-

ceptibility to environmental changes. Some adaptations are doubtless easier than others, and changes in certain directions may be easier than in others. The strength of heredity may increase when the environment remains relatively constant for long periods of time.

It is quite unnecessary and entirely unwarranted to ascribe a teleological basis for adaptation. It does not make the situation clearer to talk of entelechies or to assume a so-called vitalistic principle. We have no evidence that an adaptation is the consequence of any entities or properties different essentially, except possibly in complexity, from the characteristics of simple chemical compounds. Bone architecture may be said to be the consequence of physico-chemical processes which include among other *competing* activities, adjustments to the needs of the organism.

SUMMARY

Skeletal structures are capable of much greater changes than biologists ordinarily realize. Bones are highly adapted to their functions. Their architecture may be greatly altered as the consequence of accidents, new strains or disease.

The viewpoint is maintained in this paper, that the organism and its constituent cells have as a condition or principle of their organization adaptiveness to new conditions. This involves susceptibility to stimulation effective in heredity. There is evidence that this capacity is possessed by the germ cells as well as by the somatic cells. The doctrine of absolute isolation of the germ cells from stimulation by somatic cells which may be effective in heredity, is untenable. Much of this apparent isolation or lack of susceptibility may be due to the power of the conservative forces of heredity.

The balance in power between heredity and environmental influence may be considered to vary for different characters and organisms, very likely also for periods in activity. In the course of time, a character may become fixed, or mechanical limits may be reached for adaptation.

The architecture of the skeleton is regarded as the consequence, to some extent at least, of inherited adaptations.

The phenomena of bone architecture development and adaptation do not appear to support the ultra-Mendelian conception that new characters can arise only by recombinations of unchangeable germ-plasm units or by the loss or addition of such units.

FISHING IN VENEZUELA

By Professor A. S. PEARSE

UNIVERSITY OF WISCONSIN

FOR those reared in the temperate parts of the earth, the tropics appear as fairy lands which have a never-ending charm. To be sure, there are some stay-at-homes who worry about the heat, dread the noxious animals, and long for city-made sanitation, but to the real traveler the tropics can never be anything but delightful. It was with pleasure, therefore, that the writer boarded the good ship *Caracas* last June, bound for La Guaira.

The object of the journey was to investigate the fishes of a tropical lake, and the "Laguna de Valencia" in the northern part of Venezuela had been chosen as being the most suitable one in America. Lake Valencia is thirty miles long and, as the Venezuelans love to say, "possesses twenty-two islands, receives the waters from twenty-two rivers, and is twenty-two leagues in circumference." It is said to be fifty meters deep in some places and contains an abundance of fishes.

In the United States, the newspapers have led us to believe that Venezuela is rather pro-German, and the writer was pleasantly surprised to find that ninety-nine per cent. of the people are very much interested in the success of the allies. The officials were always very courteous and obliging. Whatever shortcomings the Spanish peoples may have, no race can excel them in courtesy. The president's son, Coronel Ali Gomez, loaned a boat, furnished a man, and did everything in his power to make the expedition a success. The Coronel is a great fisherman and went on a number of expeditions himself (Figs. 1, 2). Dr. H. Pittier, an American, Mr. Charles Lazzari and Dr. Juan Iturbe also rendered invaluable assistance. The greatest obligation, however, was to my constant companion, Agapito—expert fisherman, crack shot, philosopher and true friend. In a strange and thinly populated country one appreciates a reliable and thoughtful companion more than anything else.

The lake proved to be very interesting. It was large enough to give some variety of habitats and was inhabited by a number of strange fishes. The islands had rocky beaches, but the shores elsewhere were muddy and grown up with a dense thicket of



FIG. 1. CATCHING CORONCHOS IN THE RIO CASTANO.

rushes which stood eight to ten feet above the water (Fig. 3). The rushes were the home of the beautiful *galletas*, a sort of a rail which subsists on aquatic vegetation. There were also solemn *chiquaquos* (herons) and several smaller birds. A saber-beaked gull and a little tern hunted along the shore.

In the rushes lived the *bavas*, and we had great sport shooting them from the boat (Figs. 4, 5). Gliding along the margin



FIG. 2. COLONEL GOMEZ USING A CAST NET AMONG THE ROCKS OF THE RIO CASTANO.



FIG. 3. A BOAT BROUGHT FROM FRANCE IN SEPARATE PARTS, CARRIED A HUNDRED MILES OVER MOUNTAINS INTO VENEZUELA,
LAKE VALENCIA.

of the rushes, we strained our eyes for sleeping individuals on the rushes or watched for the four slow-moving objects above the water which marked the eyes and nostrils of a sneaking *bava* that had sighted us first. "Alli esta una"—Pedro and I held our breath. Then Agapito's rifle cracked and our paddles



FIG. 4. PEDRO AND A BAVA.

ashed the water in order that we might get the specimen before its death struggles lost it in the rushes. If it sank before we arrived, faithful Pedro (Fig. 4) stripped and dived down into the mud after it.



FIG. 5. AGAPITO AND THREE BAVAS.

None of the *bavas* in this lake were more than seven or eight feet long, but in some of the Venezuelan rivers there are caimans that reach fifteen. I had always supposed that the alligator tribe lived largely on fishes and was surprised to find that



FIG. 6. CORMORANTS ON AN OLD BOAT SHELTER.

the *baras* ate all sorts of aquatic animals. One had consumed a number of snails and a frog; the stomach of another contained nothing but ten "cuchirachis"—flat water bugs about an inch long.

Cormorants were abundant. They sat on objects alongshore (Fig. 6) and took to the water at our approach. These birds subsist on the abundant sardinas, their great diving ability enabling them to capture these with ease. The cormorants were of considerable scientific interest, as they contained the adult stages of some of the parasites which were found as larvae in fishes. One individual examined had fifty-seven trematode

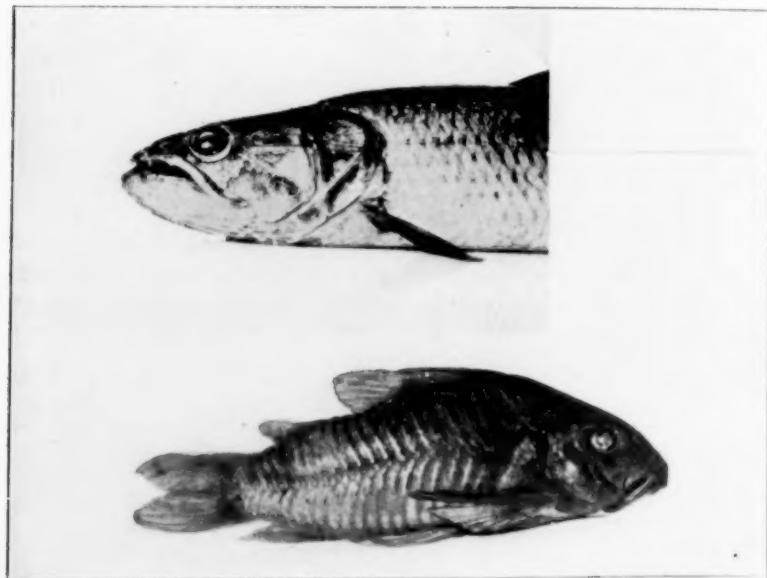


FIG. 7. A GUABINA.
FIG. 8. A PLATED NEMATOGNATH, A BEAUTIFUL LITTLE SCALED CATFISH.

worms clinging to the inside of its esophagus and about fifty nematodes in its stomach.

Sixteen or more species of fishes were found in the lake and its tributaries. In shallow water everywhere were myriads of little sardinas. These were of several species—some fed on snails, others ate algae or microscopic, floating plants and animals. Among the larger fishes the dominant one was the "guabina" (Fig. 7), a fish-eater somewhat like a pickerel, but more fierce and aggressive. Its razor teeth often cut the nets to shreds, and woe to the unwary finger that came near them!

There were several kinds of strange catfishes at the mouths



FIG. 9. TWO SPECIES OF SUCKER-LIKE FISHES: *A*, BARBON; *B*, PANIQUE.

of the rivers. The common species was much like those in the United States, but had "whiskers" nearly as long as the body. Sometimes in the creeks we caught the beautiful little plated nematognaths. These rare creatures are unique among catfishes in possessing two rows of scales on each side of the body (Fig. 8).

There were three kinds of eels. One was a gymnotid—a close relative of the famous electric eel which occurs in the Guianas. Another little species we caught on two occasions in the mud dredge at a depth of fifteen meters below the surface of the lake, where it was buried in the soft bottom mud.

Once in deep water we caught a "panaque" (Fig. 9, *B*), a strange armored creature reminding one of Devonian times. This fish is a sort of a sucker which is often found in rivers. In northern Venezuela the sucker-group has attained considerable diversity and is widely distributed. In the rivers there are several types—one species with soft barbs on the front of the head, another with a long protuberant snout, etc.

One of these sucker-like fishes, the "coroncho" (Fig. 10), is abundant in the Rio Castano near Maracay. We had great

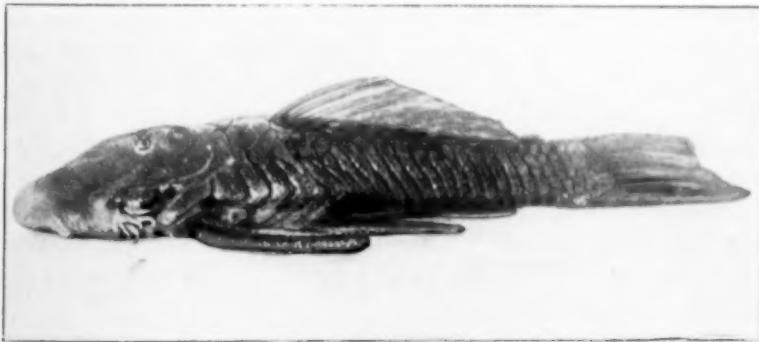


FIG. 10. A CORONCHO.

fun fishing for them "*con mano*" and with cast nets. The coroncho lurks under stones, huddled down into the sand in crevices, and firmly attached by means of its sucker-like mouth. The fisherman must lie on his belly in the water and reach at arm's length under the rocks to secure the fish. The cast net is circular and has weights all around the edge. Its use requires considerable skill (Fig. 2). It is grasped in the center and thrown so as to spread. After it has covered an area of bottom, long sticks are poked under the stones within it, and the fishes are caught as they rush from their hiding places.

Some limnological work was done in Lake Valencia. Temperatures were taken and the gaseous content of the water was determined to a depth of twenty-six meters. On July 17 the temperature of the water was as follows:

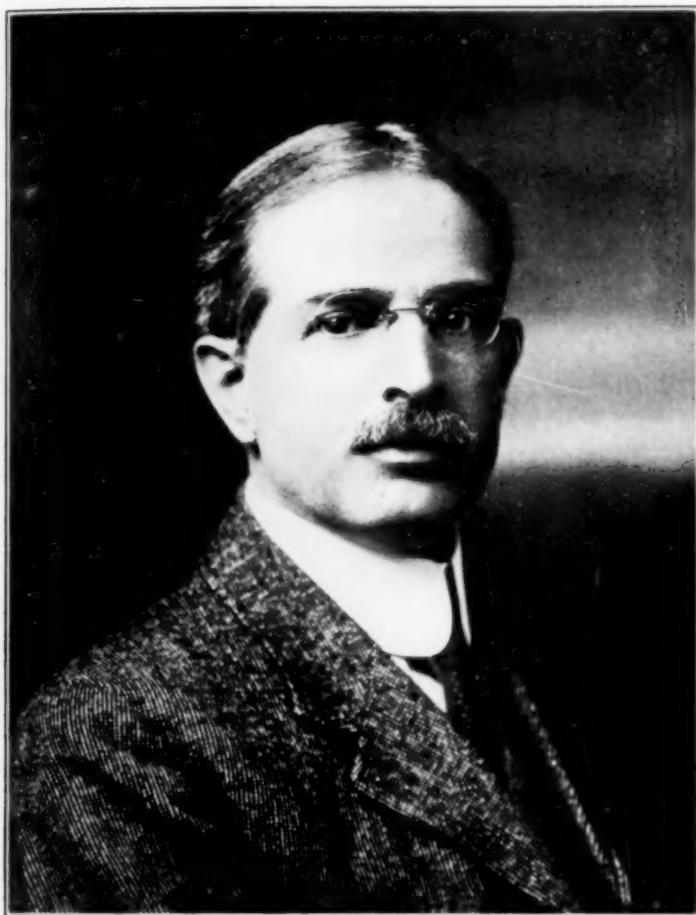
Depth in meters	0.5	1	2	3	4	5
Temperature	27.6	27.5	27.5	27.5	27.2	27.2
Depth in meters	7.5	10	12.5	15	20	25
Temperature	27.16	27.15	27.15	27.15	27.01	25.25

A slight stratification is shown, and this was also evident from the gas determinations. There was less oxygen and more carbon dioxide in the deeper water.

Catches were made at various depths with a mud dredge. The little clams (*Sphaeridae*) and dipterous larvæ, so characteristic of the bottom of the lakes in temperate regions, were absent and in their places were thousands of minute snails. A little towing was done which indicated that the plankton was less varied than that in the lakes of cooler regions.

Fishes were more abundant and varied in shallow water and few were caught below twelve meters. All the species occurring in deep water were mud-, snail- or fish-eaters.

In closing the writer wishes to point out that Venezuela is an admirable country for the naturalist. The people are hospitable and good-natured, the country is reasonably healthful, the scenery is magnificent, the fauna is varied and interesting. The writer ventures to give two admonitions to those who may plan to do scientific work there: (1) Get the backing of the government officials and you can do anything. (2) Keep in mind that those who travel in strange countries expecting to make new friends will find them. Where people are superlatively hospitable and polite, the only way to do business is with or through friends.



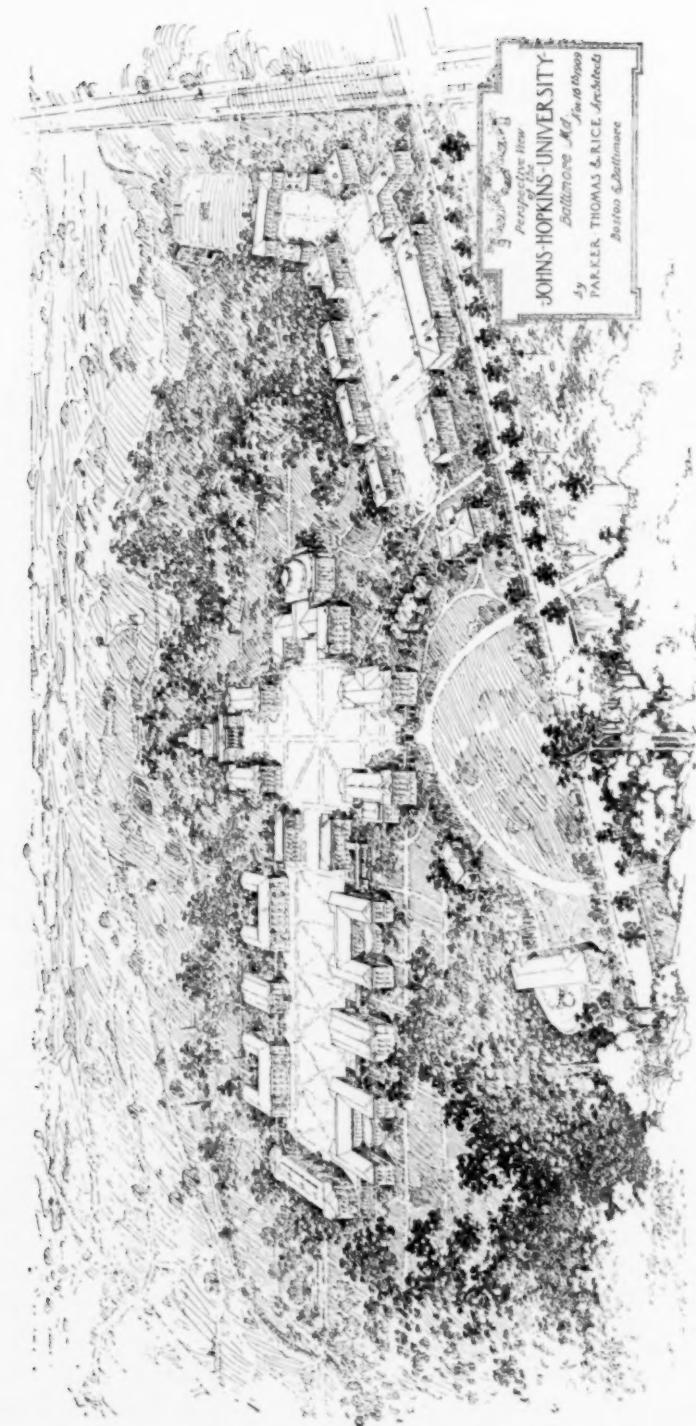
PROFESSOR THEODORE W. RICHARDS,
Retiring President of the American Association for the Advancement of Science.

THE PROGRESS OF SCIENCE

CONVOCATION-WEEK MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE American Association for the Advancement of Science and the national scientific societies affiliated with it meet at Baltimore during Christmas week. The meeting was transferred from Boston in order to

reduce as much as possible the need of travel and to be near Washington, where so many scientific men are now assembled in the service of the Government. It was necessary to set an early date for the meeting, as it was expected that the rooms of the Johns Hopkins University, used by the Students Army Training Corps, would be occupied after January first and that college and



ARCHITECT'S PLANS FOR THE DEVELOPMENT OF THE BUILDINGS OF THE JOHNS HOPKINS UNIVERSITY.



GILMAN HALL.

university teachers would be compelled to resume their teaching on that date. Though the association meets officially through the week the occurrence of Christmas Day on Wednesday has led to placing the sessions on Thursday, Friday and Saturday.

The formal opening exercises are on Thursday evening, when after remarks by the president of the meeting, Professor J. M. Coulter, head of the department of botany in the University of Chicago and President Frank H. Goodnow, of the Johns Hopkins University, Dr. Theo-



THE CARROLL MANSION AT HOMEWOOD, built in 1803, the architecture of which has been taken as the keynote for the buildings of the Johns Hopkins University.



LABORATORY OF MECHANICAL AND ELECTRICAL ENGINEERING.

dore W. Richards, director of Wolcott Gibbs Memorial Laboratory and Erving professor of chemistry, Harvard University, gives the address of the retiring president, his subject being "The Conservation of the World's Resources." Professor Richards's classical researches on atomic weights have given him distinction throughout the world, he and Professor Michelson being the two Americans who have been given the international recognition of Nobel prizes in science.

Regular meetings of the sections of the association will be held from Thursday morning to Saturday afternoon. The addresses of the retiring vice-presidents, to be delivered on those days, are as follows:

Section A.—Henry Norris Russell.
"Variable stars."

Section B.—William J. Humphreys.
"Some recent contributions to the physics of the air."

Section C.—William A. Noyes.
"Valence."

Section D.—Henry Sturgis Drinker.
"The need of conservation of our vital and natural resources as emphasized by the lessons of the war."

Section E.—George Henry Perkins.
"Vermont physiography."

Section F.—Herbert Osborn. "Zoological aims and opportunities."

Section G.—Burton E. Livingston.
"Some responsibilities of botanical science."

Section H.—Edward L. Thorndike.
"Scientific personnel work in the United States army."

Section I.—George Walbridge Perkins. (In France.)

Section K.—C.-E. A. Winslow. (Section not meeting.)

Section L.—Edward Franklin Buchner. "Scientific contributions of the educational survey."

Section M.—Henry Jackson Waters.
"The farmers' gain from the war."

About twenty affiliated societies meet in Baltimore, a somewhat smaller number than usual owing to war conditions. Among them, however, are many of the more important national societies, including those devoted to physics, geology, geography, zoology, botany, entomology, anthropology and psychology.

The meetings were planned before the signing of the armistice and were largely intended to contribute to the solution of war problems. The changed situation makes it possible to take up the immense service

of science to the nation in time of war and its dominating place in the problems of reconstruction.

The American Association met in Baltimore in 1858 and then allowed fifty years to elapse before again visiting the city. In the meanwhile the Johns Hopkins University had been founded and had created in Baltimore one of the great centers for scientific research of the country. Since the meeting of 1908 the university has moved to its new site at Homewood where the picturesqueness of the situation gives admirable opportunity for architectural development. The Carroll Mansion, built on the grounds in 1803, has been used as the key-note, and the buildings already erected house worthily one of our great universities.

AMERICAN EXPERTS AT THE PEACE CONFERENCE

ACCOMPANYING President Wilson on the *George Washington*, which sailed for France on December 4, were a number of scientific men, scholars and specialists, who, under the direction of Colonel E. M. House, have been engaged since November 10, 1917, in the offices of the American Geographical Society at Broadway and 156th Street, New York, gathering data to be used at the Peace Conference. Dr. Sidney E. Mezes, president of the College of the City of New York, is director of the inquiry and has associated with him many of the best qualified men in the nation.

In September, 1917, as a result of conferences between Colonel E. M. House and President Wilson, Colonel House was authorized to organize forces to gather and prepare, for use at the Peace Conference, the most complete information possible, from the best and latest sources, for consideration by the Peace Commissioners. Colonel House held pre-

liminary conferences with Dr. S. E. Mezes, president of the College of the City of New York; Professor James T. Shotwell, of Columbia University and Professor A. C. Coolidge, of Harvard University.

The inquiry has had a personnel of about 150 people. Among them are: Director Mezes; Dr. Isaiah Bowman, director of the American Geographical Society; Allyn A. Young, head of the department of economics at Cornell University; Charles H. Haskins, dean of the graduate school of Harvard University, specialist on Alsace-Lorraine and Belgium; Clive Day, head of the economics department of Yale, specialist on the Balkans; W. E. Lunt, professor of history, Haverford College, specialist on northern Italy; R. H. Lord, professor of history at Harvard, specialist on Russia and Poland; Charles Seymour, professor of history at Yale, specialist on Austria-Hungary; W. L. Westermann, professor of history at the University of Wisconsin, specialist on Turkey; G. L. Beer, formerly of Columbia University, specialist on colonial history; Cartographer Mark Jefferson, professor of geography, Michigan State Normal College; Roland B. Dixon, professor of ethnography at Harvard.

In addition there are eleven assistants and four commissioned officers of the Military Intelligence Division assigned to the inquiry for special problems on strategy, economics and ethnography. These officers are: Major D. W. Johnson, Columbia University; Major Lawrence Martin, University of Wisconsin; Captain W. C. Farabee, the University Museum, Philadelphia; Captain Stanley Hornbeck, author of "Contemporary Politics in the Far East." The above named, together with map-makers and other assistants, sailed with the Peace Commission on the *George Washington*.



BASE HOSPITAL IN FRANCE SHIELDED BY OAKS.

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EVACUATION HOSPITAL IN FRANCE.

**USE OF THE METRIC SYSTEM
IN THE UNITED STATES**

MORE extensive use of the metric system in the trade and commerce of the United States is recommended in a resolution adopted by the United States section of the International High Commission, of which Secretary McAdoo is chairman.

The commission has regarded this subject as of particular importance in the United States. It is, of course, unnecessary for the United States section to recommend to the Latin-American sections of the commission anything in connection with the metric system, which is exclusively in use throughout Latin



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BASE HOSPITAL IN FRANCE.

America. One of the main obstacles to documentary uniformity as between the United States and Latin America is to be found in the fact that the United States does not make the use of the metric system obligatory, and consequently its consular documents have to allow the use of that system merely as optional. Any uniform system of classifying merchandise, however, will require on the part of the United States thoroughgoing and complete adherence to the metric system.

Of more importance than statistical and administrative questions is the use of the metric system in trade. Now that the United States is obviously being drawn into closer and more vital commercial relations by the rest of the world, and particularly with Latin-America, our manufacturers and exporters will be obliged to meet the demands of their prospective customers in a somewhat more accommodating frame of mind than hitherto. Only the English-speaking nations still have to adopt the metric system of weights and measures, and among them the British Empire, or at least Great Britain, seems to be giving serious consideration to the necessity of making a change. Those who read the Commerce Reports of the United States Department of Commerce know how numerous are the opportunities necessarily allowed to pass by because of our inability to supply goods and machinery constructed in accordance with the metric system. The subject has now assumed a most practical character in the minds of those who are planning for post-war trade expansion.

SCIENTIFIC ITEMS

WE record with regret the death of George F. Atkinson, head of the department of botany at Cornell

University; of Volney M. Spalding, formerly professor of botany in the University of Michigan; of Sir Henry Thompson, professor of physiology and later of medicine at Dublin, and of H. E. J. G. du Bois, professor of physics at Utrecht.

AN Inter-Allied Scientific Conference has met in London under the auspices of the Royal Society, and in Paris under the auspices of the Academy of Sciences, to consider international cooperation in science. The American delegates are: Dr. H. A. Bumstead, Colonel J. J. Carty, Professor W. F. Durand, Dr. Simon Flexner, Dr. George E. Hale, and Professor A. A. Noyes.

THE Swedish Academy has awarded the Noble prize for physics for the year 1917 to Professor C. G. Barkla, professor of natural philosophy in the University of Edinburgh, for his work on X-rays and secondary rays. The prize in physics for 1918 and that in chemistry for 1917 and 1918 have been reserved.—The Royal Society has awarded its Darwin medal to Professor Henry Fairfield Osborn, president of the American Museum of Natural History, in recognition of his research work in vertebrate morphology and paleontology. The Copley medal goes to Professor H. A. Lorentz, late professor of physics in the University of Leyden, For. Mem. R.S., for his researches in mathematical physics; the Davy medal to Professor F. S. Kipping, F.R.S., professor of chemistry, University College, Nottingham, for his studies in the camphor group and among the organic derivatives of nitrogen and silicon; and a Royal medal to Professor F. G. Hopkins, F.R.S., professor of bio-chemistry in the University of Cambridge, for his researches in chemical physiology.